Refine Search

Search Results -

Terms	Documents
L9 and L5	9

Database: US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

Search: L12

Refine Search | Recall Text | Clear | Interrupt

Search History

DATE: Friday, March 19, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
	DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=NO; OP=OR		
L12	l9 and l5	9	L12
L11	L9 and l4	12	L11
L10	L9 and l9	21	L10
L9	(optimiz$5 and (golf adj (car or cart))) and deploy$4	21	L9
L8	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (schedul$3 adj3 maintenance)	0	L8
L7	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (schedul$3 adj3 maintenance) and (usage adj (information or record$3))	0	L7
L6	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage adj (information or record$3))	0	L6
L5	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance)	11	L5
L4	l3	25	L4

h e b b cg b e e ch

L3	(optimiz$5 and (golf adj (car or cart))) and (id or identification)	25	L3
L2	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification)	0	L2
L1	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification) and (odometer or (axle adj revolutions) or milage)	0	L1

END OF SEARCH HISTORY

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Refine Search

Search Results -

Terms	Documents
(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (schedul$3 adj3 maintenance)	0

Database: US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

Search: L8

Refine Search | Recall Text | Clear | Interrupt

Search History

DATE: Friday, March 19, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=NO; OP=OR			
L8	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (schedul$3 adj3 maintenance)	0	L8
L7	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (schedul$3 adj3 maintenance) and (usage adj (information or record$3))	0	L7
L6	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage adj (information or record$3))	0	L6
L5	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance)	11	L5
L4	l3	25	L4
L3	(optimiz$5 and (golf adj (car or cart))) and (id or identification)	25	L3
L2	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification)	0	L2
L1	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification) and (odometer or (axle adj revolutions) or milage)	0	L1

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END OF SEARCH HISTORY

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L4: Entry 5 of 25 File: PGPB Mar 28, 2002

DOCUMENT-IDENTIFIER: US 20020038178 A1
TITLE: Golf navigation appliance

Summary of Invention Paragraph:
[0034] Expediently, a sensor arranged at a physically separate point has an identification feature which can be transmitted by the transmission device. Such an identification feature has the advantage that measurement data transmitted to the golf navigation appliance by the transmission device can be associated with the respective sensor by virtue of the identification feature. This is particularly significant if game progressions for a plurality of pedestrians or golf players are to be recorded by one (golf) navigation appliance, since the respective position data for the individual players can then be associated with them.

Summary of Invention Paragraph:
[0066] Such position-finding can be advantageous particularly if another sufficiently accurate absolute position-finding method, such as differential GPS, is not available and exclusive integrated position-finding starting from the shot is too inaccurate, for example on account of the fact that the player goes round in a large number of loops searching for the ball after a shot into the rough. Integrated position-finding can also be inaccurate or impossible if the player is using a golf cart or alternately covers distances on foot and using the golf cart. A cross-bearing can then be taken as required to ascertain a new absolute position as the starting point for further integrated navigation.

Detail Description Paragraph:
[0113] FIG. 10 shows calibration of the integrated navigation. In a first step 362, the procedure detects whether the target on a hole 13, that is to say normally the pin 14, has been reached. This can be done automatically by comparing the current position with the known position for the pin 14, or can be verified by requesting a user input. In a subsequent step 363, the distance between the target's position known from the digitized golf course map and the current position is determined. In a subsequent step 364, the procedure determines whether the distance is greater than a permissible maximum discrepancy. If this is the case, then an optimization calculation is performed in a subsequent step 365, this calculation being used to ascertain 366 correction factors for the distance and to ascertain an offset for the magnetometer 105, 205. An optimization calculation 367 is then performed to modify parameters for a model and to modify polynomial coefficients. The offset for the compass sensor 205 is also used to modify the direction determination 368. Optimization is expedient because integrated position-finding produces errors which add up over time to give growing divergences from the true location. The starting point for integrated position-finding is the tee 12 on a hole 11. The end for integrated position-finding is the pin 14 on the same hole 11. The positions of the two points are known from the digital map. The actual game progression corresponds to an uncertain polygonal move from the tee 12 to the pin 14. If errors have arisen in the calculation, then the polygonal move does not end at the pin 14. This error is minimized on the basis of magnitude and direction in an optimization calculation. Parameters for the optimization may be as follows: errors in the pace length estimation, errors in the compass. Examples of advantageous methods are as follows: last square, Rosenbrock's optimizer. The two stated parameters are varied until the error assumes a minimum. The resultant variations in the pace length and

the walking direction are incorporated into the rest of the integrated position-finding.

Detail Description Paragraph:
[0116] The text below describes detection of running or walking. One parameter used is the variance in the acceleration values az. The variance's cyclical values over one walking pace are smoothed using a low-pass filter. The values are stored, so that past values are available for the variance in the acceleration values. The respective current value for the variance in the acceleration az is compared with the past values; a rapid rise in the variance value switches a binary selection signal, which indicates a state of walking or running, to a HIGH state, and a rapid drop switches it to a LOW state, otherwise the state of the signal remains unchanged. It is also possible to provide a signal or signals which indicates a change of state. The HIGH state of the signal can deactivate at least part of a model for the walk-estimator, in order thus to prevent incorrect estimations by the model formed only to estimate walking motions. Preferably, this is done by applying the selection signal as an inhibitor signal for the optimization calculation 367. If a model is available for estimating running motions (run-estimator), this signal can be used to change over to the run-estimator. FIG. 13 shows examples of the variances in the acceleration az over the speed v for walking 131 and running 132.

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L4: Entry 6 of 25 File: PGPB Feb 7, 2002

DOCUMENT-IDENTIFIER: US 20020016674 A1
TITLE: Golf course yardage and information system having improved zone information and display characteristics

Summary of Invention Paragraph:
[0007] Huston proposed a golf course GPS system which employs purely conventional differential GPS, which has found wide use to reduce errors in distance measuring systems. The differential GPS (DGPS) system broadcasts error correction information from a ground receiver of known location in the vicinity of the user. Two GPS receivers are used, one at a known fixed position, so that the difference between that known position and its position calculated from the satellite GPS signal fixes the error in the signal. The fixed position (reference) receiver provides a continuous correction for use by all other receivers, which may be mobile, within its reception area. Knowledge of the error allows all distance and position calculations at the user's receiver to be corrected. Conventional DGPS can reduce errors in position calculations to allow accuracies of within about five meters quite suitable for most commercial needs, but still unacceptable for a golf course distance measuring system. However, the same conventional DGPS system may be used to determine the location of a golf cart receiver relative to the pin on a hole of a golf course as to determine the location of a ship relative to a land-based point of interest. Weather conditions and terrain have little effect on position determination in the GPS system, and few restrictions are imposed on size or location of a user's receiver.

Summary of Invention Paragraph:
[0015] Another object of the present invention is to provide such a system having the capability of detecting when the golf carts are within predetermined zones or regions of the golf course for use in unique system features such as automatic display of the current hole on the monitor of each golf cart, measuring the pace of play for each hole, and automatic pop-up advertisements on the monitor of each golf cart as the carts transition from one hole to the next.

Summary of Invention Paragraph:
[0016] Another object of the present invention is to provide an improved technique and method for mounting a monitor to the roof of a golf cart for exceptional color readability in sunlight.

Summary of Invention Paragraph:
[0018] The PROLINK system includes a golf cart-based subsystem, although it may be packaged alternatively or additionally into a hand-held unit carried by the golfer. Both such versions are included within the generic terminology of a mobile unit, a portable unit, or a roving unit. Each roving unit utilizes state-of-the-art DGPS technology, with considerable enhancement by the features and aspects of the present invention, incorporated in hardware and software.

Summary of Invention Paragraph:
[0026] The course management portion of the PROLINK system includes a base station computer unit, receiver/transmitter unit and video monitor in the clubhouse (or other desired location) to give the course administrator better insight into daily operations and revenues. Principal advantages of the course management portion

include (1) the capability to identify, locate and monitor movement of every golf cart on the course in real-time, with precise positioning during play on each hole, (2) use of that knowledge to pinpoint location and analyze cause of bottlenecks, toward improving speed of play, and greater enjoyment by all players, (3) compilation of an extensive computerized data base to provide management and designated staff personnel with accurate statistical insight into course operations and techniques for instituting improvements, and (4) availability of a convenient source of communication and messaging to all roving units, with potential concomitant revenue enhancement through advertising and promotions.

Summary of Invention Paragraph:
[0028] The size of a golf course's ranger staff may be reduced by virtue of having a wealth of information available to the course administrator from the PROLINK system. Despite their fewer number, the rangers may be used more efficiently by dispatching them to precise locations where bottlenecks or other barriers to efficient play are occurring. Each roving unit is assigned a unique ID number which is transmitted by the system for periodically monitoring (and displaying) (e.g., every 2 to 16 seconds, depending upon the number of carts on the course) each unit during play, for identifying selected golfers for messages, or those who may be causing problems, or for other purposes.

Summary of Invention Paragraph:
[0030] The PROLINK system also employs a unique technique and method for collecting data indicative of the layout of the golf course including such features as tee boxes, greens, fairways, water hazards and sand traps. Such collected data is then post-processed and efficiently stored in memory in vector form for later retrieval and display. Moreover, once the data representing the golf course is stored in memory, such data can be used to efficiently determine the location of a golf cart relative to predetermined zones or regions. To that end, the PROLINK system utilizes a unique zone detection algorithm and creates a number of different zones corresponding to actual areas or objects on the golf course. For example, zones are created corresponding to a tee box area or a green area of a particular hole on the course. Accordingly, the PROLINK system has the capability to detect a golf cart to be within an actual area on the golf course when the coordinates of the golf cart lie within the corresponding zone.

Summary of Invention Paragraph:
[0031] By the use of such a zone detection algorithm, various features of the PROLINK system are readily implemented. Such features include automatic hole display on the cart monitor as the cart enters the tee box zone of a new hole, and automatic pop-up, high resolution, color advertisements when the cart is in transition from one hole to the next. Additionally, the speed of play for a hole may be obtained by measuring the time from when a golf cart enters the tee box zone of a hole to when the cart exits the green zone of that hole.

Brief Description of Drawings Paragraph:
[0059] FIG. 26 is a pictorial diagram illustrating the mounting of a monitor to the roof of a golf cart for promoting enhanced sunlight readability.

Detail Description Paragraph:
[0060] Referring to FIG. 1A, a presently preferred embodiment of the PROLINK system includes a base station 10 (sometimes referred to as the course management station, or CMS) located at a convenient place on the golf course premises such as in the clubhouse (preferably, in the pro shop). The CMS includes a computer (sometimes referred to herein as the course management computer, or CMC). The present invention also includes software to be described hereinafter for execution by the CMC. A related GPS receiver 11 (a Navstar XR5-M6 GPS receiver in the preferred embodiment) receives transmissions from GPS satellites such as 14, and a transceiver 12 provides two-way radio frequency (RF) communication with a multiplicity of mobile receivers which may be cart-based (as at 15) or hand-held

units (handsets, not shown). From time to time, the mobile units will be referred to herein as roving units. In the preferred embodiment, each roving unit is cart-based, i.e., installed on its own golf cart 16, but could be a hand held unit, if desired.

Detail Description Paragraph:
[0063] The monitor 19 is shown in somewhat more detail in FIG. 1C. It is mounted at the underside of the roof 20 of golf cart 16, and is turned on (together with the other electronics in the cart-based unit) at the time the cart is checked out from the course cart shop. Except for an advertising display presented prior to play and between holes, the monitor normally displays the layout of the hole being played, and this is done automatically (as the default display) as the cart approaches within a predetermined distance of the tee boxes for the hole. Alternatively, the user (typically, the golfer playing the course, although maintenance people and others may at times use the cart) may select some other option at any particular time by operating keypad control buttons 23 on a control panel mounted just under the monitor in the cart roof. The components of cart-based PCU 16 will be described in more detail later.

Detail Description Paragraph:
[0065] The golf carts in which the roving units are installed are normally garaged at a course cart shop when not in use. The cart attendant, who obtains identification from each golfer/renter at the time the cart is checked out, may record this information for subsequent entry of the golfer's name and the ID number of the respective cart into CMS 10 for correlation purposes. With this information available for instant readout, any personal messages that may need to be directed to a player during a round of golf can be communicated to that player's cart anywhere on the course.

Detail Description Paragraph:
[0070] Information transmitted from the CMS 10 to each CBU 15 includes DGPS corrections for CBU computation of position, velocity, and distances. Also, network control data provides essential timing information for the base station/cart communications, messages, dynamic object status (such as pin placements and tee box locations), initialization message with time and position data to `cold start` the CBU GPS receivers if required, and golfer names and start times information for the course rangers. Information supplied by each CBU to the CMS includes the location of each golf cart by ID, message information from the golfers, pace of play data and player score and statistics information for post-play output.

Detail Description Paragraph:
[0074] BRIU 37 includes a GPS subsystem 42 with antenna 43, a primary PROLINK computer unit (PCU) 44 with antenna 45 for transmitting and receiving data packets to and from each of the carts, a secondary PROLINK computer unit (PCU) 51 with antenna 52 for monitoring frequencies before transmission and for broadcasting a station identification to assure compliance with the Federal Communications Commission regulations,, and interface converter 53 for providing an interface between BRIU subsystem 37 and CMC 41. BPIU 37 may optionally include a relay PROLINK computer unit 55 for courses with particularly harsh terrain that may not be line-of-sight with the BRIU to assure reliable radio communication.

Detail Description Paragraph:
[0078] CMC 41 serves as the master control for the entire PROLINK system. It may, for example, be an IBM-compatible 486-based 66 MHz PC (personal computer) with 8 megabytes (MB) of RAM (random access memory), an 200 MB hard drive, and extended graphics capability with a local bus video system, a video accelerator high-resolution card having 1024 pixels vertical resolution and 1280 pixels horizontal resolution, and nominally 256 colors. In addition to its capabilities described above, this computer enables asset (e.g., golf cart-based units) management by the course administrator. The course digital map display 54 is preferably a color video

(computer) monitor with 17- to 21-inch screen size.

Detail Description Paragraph:
[0085] Each cart with a roving unit is assigned an ID number to be incorporated in the header of a message packet for communication with the golfer(s) who rented the cart. Correlation of golfers with carts is performed by entering data into the CMC 41 by an attendant at the time of cart checkout. On completion of play of the round, the CMC may be activated by a trigger signal when the cart departs from the 18th hole, or by manual selection, to compile the stored data for the individual player's statistics for that round, including drive distance on each hole, score for each hole and total score, play times, and so forth. This statistical data is then available to the course manager and to the golfer in the form of a hardcopy printout or computer disk. As a result, the golfer is able to replay and analyze his or her game at a convenient time at home.

Detail Description Paragraph:
[0088] Upon completion of system initialization, a number of tasks are commenced. Thirty-two (32) hertz (Hz) task 62 when activated sends out morse code data to enable the secondary PCU 51 to broadcast the station identification on the RF communication channel that CMS 10 is currently operating on.

Detail Description Paragraph:
[0099] Another significant aspect of the system software according to the invention is the use of a windowing graphical user interface which is tailored to support real-time operating systems by requiring only relatively little CPU throughput for operation. The graphical user interface utilizes on-screen windows that contain important information to the particular user, and is employed on both the golf cart mobile unit display and the course management display.

Detail Description Paragraph:
[0104] The PROLINK system has the capability to send information bi-directionally between the clubhouse base station and the golf cart roving units. The CMC must send a significant amount of information to the roving units, such as differential GPS corrections to assure that the carts have very accurate yardage information, personal and global messages to golfers, pin placement and tee box location updates to golfers on the course, and so forth. Similarly, the mobile units need to send information to the CMC such as the state of the course, the cart position, time of play for a given hole, general information or requests from golfers such as to send the refreshment cart and so forth.

Detail Description Paragraph:
[0128] The PROLINK system provides command and control with bi-directional communications between a commander (the PROLINK base station) and a plurality of control assets (individual roving units, such as PROLINK-based golf cart). In the presently preferred embodiment, a variable length packet network is used for communications, in which digital messages containing data packets are transmitted between the base station and the roving units in a half duplex Time Division Multiplex (TDM) digital communication system. Each communication message may be a single packet or multiple packets, but available channel bandwidth is maximized by putting as many packets as can be accommodated in each message.

Detail Description Paragraph:
[0129] Each message has a message identification header. In general, bit synchronization information is provided at the beginning of each message, but long messages may also contain synchronization information in the middle or at the end of the message. Each packet has an identifier uniquely determinable from other packets in the message, and is embedded with error detection mechanisms.

Detail Description Paragraph:
[0140] No interruptions of a frame or a frame cycle are allowed in mid-execution.

Rather, all interruptions in frame broadcast are restricted to the beginning of an integer second at the beginning of the frame cycle. The base is responsible for timing interrupts accordingly through the use of base packet 3 (network control). On reception of network reconfiguration commands in base packet 3, all carts must wait until the end of the frame cycle before enacting the configuration change command. Examples of frame interrupts are (i) preparation for a station identification broadcast, (ii) a network reconfiguration, and (iii) network duty cycle control.

Detail Description Paragraph:
[0165] In the PROLINK system, the network configuration will be required frequently during normal network operations. Activities such as entry of additional carts into the network, transitioning channels and embedding a transmit/receive duty cycle to meet shared channel requirements, and station identification broadcasts, among other possibilities, necessitate network configuration changes.

Detail Description Paragraph:
[0177] When a change of channel is decided, the base maintains the upper nibble of byte 5 set to the new channel over the entire frame cycle so that all carts are notified. Once a channel change is declared, it is not subject to change in mid-cycle, which means that a problem could erupt if a shared channel user were to usurp the channel in a frame cycle period and find that the entire network is displacing it on the selected channel at the end of the first frame cycle. To avoid this, however, PCU 51 transmits a Morse Code station identification on the new channel immediately after the channel change has been declared and for that entire frame cycle, so that the PROLINK system immediately "claims" the new channel when it is available, and satisfies the FCC identification requirement.

Detail Description Paragraph:
[0183] Network Station Identification

Detail Description Paragraph:
[0184] FCC rules require that the base broadcast a Morse code station identification at least once every 15 minutes. This is done automatically by the scanning receiver just before every network channel change when the new channel is claimed, after an old channel is left, and during duty cycle off periods.

Detail Description Paragraph:
[0217] The base message consists of a bit synchronization word (16 bits), a message identification byte (8 bits), a number of message bytes, a header error detection byte, and packets, as defined in the following Table.

Detail Description Paragraph:
[0219] A Motorola 68332 Time Processor Unit (TPU) is used for bit synchronization. To support TPU detection of bit synchronization, the bit sync word is BFFF.sub.hex, and the most significant bit (MSB) of the message identification byte must be low. Also, a selected bit, for example bit 14, of byte 2 is chosen to be high to distinguish a cart-based message from a base station message. Thus, a maximum of 64 (7F.sub.hex-40.sub.hex) messages may exist. Details of bit synchronization are discussed below.

Detail Description Paragraph:
[0222] Each base packet has a common structure with unique contents to support software commonality. The common structure is a header byte in the byte 0 packet position, and an error detection word or words as the last four bytes in the packet. The MSB of the header byte may be set to request an acknowledge from the receiving rogue(s), so that up to 128 unique packets can be transmitted from the base to the rogues. For example, a packet identification of 81.sub.hex is identical to 01.sub.hex to the receiving rogue except the 81.sub.hex case requires a hard "acknowledge" from the rogue while an 01.sub.hex does not. A total of 6 base

packets is used in the preferred embodiment, viz., (1) a DGPS packet, (2) a text message packet, (3) a pin/tee box placement packet, (4) a network control packet, (5) a rogue control packet, and (6) a system data packet. The contents of these packets are defined below.

Detail Description Paragraph:
[0230] The packet identification byte (0) for the DGPS packet is 0, by definition. An 80.sub.hex requires the rogue to acknowledge the successful receipt of the packet; a 00.sub.hex does not. The data sub packet is of length i, determined by the rogues from the sub packet type defined in the header sub packet, and N data sub packets of the same type are included in one DGPS packet. The DGPS packet is the only packet that does not have error detection since there is adequate error detection on all sub packets.

Detail Description Paragraph:
[0235] The sub packet type is equivalent to the RTCM-104 message type (frame ID).

Detail Description Paragraph:
[0245] Byte 0 contains a pseudo range/range rate scale factor, User Differential Range Error (UDRE), and satellite identification, as shown in the following Table.

Detail Description Paragraph:
[0259] The text message packet enables the course manager to send a common message to all roving units (golf carts), or to send specific messages to any individual golf cart. A common message, for example, might be the score of a game, a lunch special, or other information which the course manager desires to transmit to all active carts. A unique message to a specific cart might be warnings regarding unauthorized behavior (e.g., driving the cart on the green), or a message from a business associate. Up to 24 characters can be transmitted at one time in a packet; however, up to 16 frames of the packet can be transmitted, which allows a total message length of 384 characters including punctuation and spaces (amounting to about five full text lines). The roving units do not display any part of the message until all frames have been received successfully. At that time the entire message is displayed in a pop up window.

Detail Description Paragraph:
[0262] The packet identification (byte 0) for the text packet is 1. A cart address (byte 1) of 00.sub.hex is the all call address and is set if it is desired for all carts to receive a transmission. Any other address will communicate only with the specific cart number identified by the address, and with no other carts on the course.

Detail Description Paragraph:
[0268] The pin/tee box placement packet is preferably assigned the lowest order of packet transmission priority, which is to say that if a base message has no space available, broadcast of the pin/tee box placement packet may be deferred to a subsequent frame in which space is available. Partly for that reason, although the 18 packets should be periodic on 16 second intervals, they may be distributed in any desired sequence throughout the 288 second interval to optimize message loading. This particular packet structure is defined in the following Table.

Detail Description Paragraph:
[0270] The packet identification (byte 0) is 2, by definition. The hole number (byte 1) can range theoretically from 1 to 255 with an 8-bit byte, although nothing beyond coverage of a 54 hole course would be required as a practical matter. The pin position for the hole is precisely indicated by bytes 2-3 and 4-5, while bytes 6-7 indicate all tee box locations. For instance, the upper nibble of byte 6 contains the tee box number that is the active front tee box, and the lower nibble of byte 6 contains the tee box number that is active in the front-middle position. Similarly, the upper and lower nibbles of byte 7 indicate active back-middle and

active back (championship) positions of the respective tee boxes.

Detail Description Paragraph:
[0275] The packet identification (byte 0) is 3. An 83.sub.hex requires the cart to acknowledge successful receipt of a packet, whereas an 03.sub.hex requires no acknowledgement. The Rockwell Navcore V GPS engine receives its initialization data from the network control packet (bytes 1-4) as shown in the above table. The GPS time (bytes 1-4) is broadcast in a different format from that required by the Rockwell Navcore V, to save bandwidth. The GPS week (bytes 1-2) started (week 0) on Sunday morning, Jan. 6, 1980. Bytes 34 contain the number of seconds since the beginning of the GPS week scaled at 10 seconds per bit. The CPU card should reformat the time data to that required by the Navcore V. In addition to time, the GPS engine needs the initial position for rapid acquisition. Since each cart has the defined location of the origin of the course map coordinate system in memory to support course reference frame positioning, this latitude, longitude and altitude can be used to initialize the GPS engine.

Detail Description Paragraph:
[0281] Network duty cycle is to provide off time for compliance with the FCC shared channel rules and to ensure there is an off time available for transmission of the channel id Morse code signal. The most significant 5 bits of byte 8 (bits 7-3) define the network on-time, and the least significant 3 bits define the network off-time. Byte 8 is further described by the Table below.

Detail Description Paragraph:
[0290] The rogue control packet identification (byte 0) is 84, by definition. An 84 00.sub.hex requires acknowledge of the cart's successful receipt of the packet. The cart address (byte 1) is the identification (ID) number assigned by the course administrator to the cart, and ranges from 1 up to 255 carts. Address 00.sub.hex (the "all call" address) is not allowed, because the rogue control packet is only intended for a specific cart.

Detail Description Paragraph:
[0299] Byte zero is the System Data Packet ID. Byte one is the time zone offset for UTC time for the particular location of the PROLINK system quantized at 15 minute intervals. The time zone information allows accurate display of local time to golfers during their round. Bytes 2-7 are spares for future expansion. Bytes 8 and 9 are the (20,1) code error detection bits with the upper nibble of byte 8 being used for byte 0 and 1 error detection, the lower nibble of byte 8 being used for byte 2 and 3 error detection and so on through byte 7 of the packet.

Detail Description Paragraph:
[0304] The cart message consists of a bit synchronization word (16 bits), a combination message identification and packet identification word (16 bits total), and the actual packets. This format is truncated significantly from the base station format for bandwidth efficiency; however, the messages maintain uniqueness between the base station and the carts for easy identification. The cart messages are an exact fixed length (9 bytes), and the base station uses this information to compute the checksum for error detection. The cart message structure is illustrated in the following table:

Detail Description Paragraph:
[0306] The bit synchronization embedded in the cart messages (bytes 0 and 1 BFFF.sub.hex) is identical to that of the base messages. The message and packet identification are quite different, but are easily separable as follows.

Detail Description Paragraph:
[0308] The MSB of the message/packet identification word must always be low to support bit synchronization. The next 8 bits (bits 14-7) define the cart address, the next 3 bits (bits 6-4) define the cart packet type with up to 8 packets

supported, and the last 4 bits support error detection. To prevent confusion with an "all call" address, the cart address cannot be 00.sub.hex.

Detail Description Paragraph:
[0327] The Distance Traveled/On-Time Packet contains the total distance traveled by the golf cart during the round of play. Additionally, the packet contains the total time that the PROLINK system has been on for the round. This packet is only broadcast at the end of each golf round and is defined in detail below:

Detail Description Paragraph:
[0373] Referring now to FIG. 12, in which like reference numbers to those used in FIGS. 1, 2 and 3, for example, refer to like portions of the PROLINK system, a detailed block diagram of the electronic components of cart-based units 15-1 is shown. The GPS data are received by the cart 15-1 from the satellites 14-1, . . . , 14-n, together with data from the base station (course management station) 10 on the course communications network. The cart includes a cart-based unit (CBU) PROLINK Computer Unit (PCU) 16 which is substantially similar to primary PCUs 44 and 51 (of FIG. 4) with the exception that PCU 16 additionally includes a GPS engine (17) while PCUs 44 and 51 utilize GPS subsystem 42 of FIG. 4. Cart-based PCU 16 includes a CPU/video controller card 18, GPS engine 17, digital data transceiver/RF card 22, and power distribution card 24, and interacts with keypad 23 and color monitor 19. Power distribution card 24 is supplied by a cart power interface box 25, which is itself energized by the cart batteries. The color monitor assembly 19 is mounted inside the golf cart below the roof for ease of viewing by the cart occupants without interfering with the driver's view of the cart path. Such mounting of monitor 19 is significant for allowing color readability in sunlight, the details of which will be discussed later. The key pad assembly 23 mounted below the base of the monitor allows ready access by the cart operator. The PCU 16 is embedded in the cart roof, and a cart power interface box 25 is mounted in the cart out of the way of the occupants.

Detail Description Paragraph:
[0377] A Cart Power Interface Box (25) is mounted under the seat of the cart or could alternately be mounted underside of the roof of the cart, alongside PCU 16. As shown in FIG. 12, a pair of wires run from the DC power supply (typically several batteries supplying +36 volts) and the ground reference of the golf cart into the roof assembly and to the cart power interface box. The power interface box converts this unregulated 36v supply to unregulated 15v DC which is used to power PCU 16, and to 120v AC used to power monitor 19. The PROLINK electronics use unregulated 12-15v DC as the primary power source because similar system concepts are applicable not only to the golf market, but to many other markets as well. For example, unregulated 12v power is readily obtained from many types of motor vehicles, tractors, aviation equipment, airplanes, and so forth.

Detail Description Paragraph:
[0393] The CPU interface to an RF card at the roving unit enables each golf cart to communicate information to the base station RF card located in the pro shop or other convenient location on the course. The antenna location either provides good direct line-of-sight communication to all carts on the course, or can be adapted to do so by means of repeaters, reflectors or the like as previously described herein. The mobile (roving unit) RF receiver receives data from the base transmitter and stores it in memory for use in calculating its position and for other tasks. The mobile RF transmitter transmits serial data to the base station receiver identifying the cart and its location every few seconds. By virtue of these transmissions, the specific location of each cart is determined and identified on the digital mapping display on the base station monitor.

Detail Description Paragraph:
[0405] The PROLINK transceiver must be able to send digital data to support PROLINK unique requirements, and Morse code station identification data to support FCC

requirements. A solid state switch is used to pass either the digital data, or the Morse code information. The PROLINK transceiver has no provision to send traditional analog voice information. Even though only digital data or a Morse code tone is transmitted, an audio low pass filter has been implemented to prevent any possibility of over modulation of the transceiver. The low pass filter is a third order Butterworth design and completely meets the FCC requirements. Additionally, the transmit binary digital data stream edges are rounded to reduce the modulation index and hence the occupied bandwidth of the transceiver. The PROLINK digital modulation circuits physically can not have a frequency deviation of more +4 kHz by design in that the varactor tuning range is incapable of anything greater.

Detail Description Paragraph:
[0420] The outline of each object on the golf course is determined by collecting DGPS position data around the perimeter of each object. Objects that are simply linear such as golf cart paths or narrow streams are surveyed by collecting data along them from one end to the other. The output of the GPS receiver as it is moved along the object perimeter are geodetic coordinates at regular time intervals, typically 1 per second. It is understood that universal transverse mercator (UTM) coordinates could also be used instead of geodetic coordinates. These coordinates are stored for later post-processing as will be discussed shortly. Moreover, each object is identified by a unique object number and an object type to determine how it is post-processed and drawn when displayed.

Detail Description Paragraph:
[0439] Once the outline of the golf course has been obtained and stored in the manner described above, such data can be used to generate an efficient method for determining and detecting the location of a golf cart within various zones or regions of the golf course. Such a zone detection algorithm is necessary to implement system features such as the automated hole display sequencing, whereby color monitor 19 of the golfer's cart automatically displays the current hole being played, and the speed/pace of play timing both of which require knowledge of where the golf cart is relative to important zones/regions within the golf course such as a particular tee zone or green zone.

Detail Description Paragraph:
[0440] The PROLINK system is based on a concept of "zones" which can be defined geometrically such as by a circle, an ellipse or a rectangle. The zone is created by encompassing the area of interest with one or more of the desired geometric shape. With this mathematical description of each area via the zone shapes, the coordinates of a golf cart can be compared against each zone to determine whether or not the golf cart is inside a specific zone, and hence in a specific area of interest. As an example, a rectangular zone shape is very efficient for this application. A rectangle on the golf course map can be described on an x-y coordinate grid by its center (X0, Y0), semi-major and semi-minor axis DX and DY, and rotation angle .alpha. of the semi-major axis with respect to the survey grid x axis. Given the specific coordinates of a golf cart as denoted by (x,y), as determined by the cart's GPS system and corrected by the cart's computer system, it can be determined if a golf cart is inside the rectangular zone using the following equations.

Detail Description Paragraph:
[0441] If the absolute values of dx and dy are respectively less than DX and DY, then the golf cart is inside the rectangle and hence inside the area of interest. To improve computation speed, the sine and cosine of the rotation angle .alpha. may be computed a priori and stored in memory. Moreover, the algorithm can be formulated to use scaled integer arithmetic to further improve speed.

Detail Description Paragraph:
[0442] By the use of such zone detection algorithms, the PROLINK system has the capability to determine when a golf cart enters any predetermined zone within the

golf course. Accordingly, the feature of automatic hole sequencing can be accomplished whereby when the system detects that the golf cart leaves the green area of hole 1 and subsequently enters the tee box area of hole 2, the stored outline of hole 2 can be automatically displayed on the color monitor of the golf cart. Moreover, the feature of automatically displaying high resolution color advertisements as the cart travels from one hole to the next may be implemented by detecting when the golf cart has just exited an area associated with the green region of a hole and is in transition to the tee box region of the subsequent hole. Additionally, the feature of automatically determining and recording a golfer's pace of play for a hole may be accomplished by starting a timer when the golf cart enters the tee box region associated with a hole and stopping the timer when the golf cart leaves or exits the green region associated with that hole. This feature and algorithm will be discussed in more detail later.

Detail Description Paragraph:
[0459] Accordingly, since GPS velocity data is typically better than position data, the PROLINK system uses velocity data to reduce position errors. This is accomplished through a filtering mechanism known as a complementary filter. Referring to FIG. 24, a block diagram-illustrating complementary filter 301 for blending position data with velocity data to improve position accuracy is shown. Such a filter is used in the X and Y horizontal axes; the PROLINK system does not display altitude data, so special filtering is not performed in the Z axis. In operation, measured velocity, V, which is a function of time; is integrated via integrator 302, to produce an estimate of position as denoted by P'. The difference between the measured position (P) and the estimated position (P') is calculated via subtractor 304 when P and P' are also functions of time. This difference is then fed back to adder 306 to correct the measured velocity via feedback gain element 308. A low feedback gain gradually blends position measurements to correct slow drift in the position estimate from the integrated velocity. A value of K between 1/30 and 1/50, for example, provides a good balance between position and velocity measurement errors for a low dynamic vehicle such as a golf cart.

Detail Description Paragraph:
[0461] The PROLINK system additionally includes a range display filtering mechanism for insuring that the display provides a fixed constant yardage readout when the golf cart is not moving. For a yardage measurement system, the golfer expects to see a constant yardage readout when the golf cart is not moving. However, without special processing, the yardage estimate may change slightly due to measurement noise even though the golf cart is stationary. The PROLINK system solves this problem by utilizing a unique zero velocity filtering algorithm for freezing the yardage readout when the golf cart is detected to be stationary.

Detail Description Paragraph:
[0462] To that end, the PROLINK system utilizes the fact that electrically-powered golf carts typically have a minimum speed when under power on level ground. Slightly depressing the pedal turns the electric motor on at a minimum RPM (revolutions per minute). The minimum speed is roughly 0.15 meters per second, which is above the typical velocity magnitude error for differential GPS navigation systems. The PROLINK system uses a filtering algorithm that averages a number of past velocity measurements, for example 4, such that if the output of the filter is below 0.15 meters per second, the golf cart is assumed to be stationary and the display of yardage is frozen on the screen. Therefore, when the golf cart is stationary, the user always observes a yardage readout that is constant and does not flicker between two or more different readouts.

Detail Description Paragraph:
[0464] By making use of the zone detection algorithm, the PROLINK system has the capability to determine the length of time it takes a golfer to play a hole, a selected plurality of holes, or an entire round of golf. The PROLINK system allows the capability of both the golf cart and the course management system to keep track

of the play time using similar algorithms. Briefly, the course management system displays a running timer for each golf cart for the current hole and the round and play times for each hole completed. The golf cart computes the play times for each hole and transmits its times to the course management system. The course management system stores the play speed data for each golf cart so that it may be analyzed off-line.

Detail Description Paragraph:
[0465] Golf is typically played by moving from tee to green and then to the tee of the next hole. By making use of this fixed sequence of events and the previously described zoning algorithm, the play speed times for each hole can be computed. Referring back to the zoning algorithm, the PROLINK system has defined predetermined zones or regions around the tee boxes and greens (as well as other objects) of each hole to encompass the areas where players usually park their carts while teeing off and putting. The zone detection algorithm may be used to determine if the cart is near a tee or a green. The time required for the golf cart to move from the tee box of a hole to the tee box of the next subsequent hole is the play time for that hole Time is kept for each hole by using the CPU clock which, as previously described, is calibrated with GPS time from the GPS receiver.

Detail Description Paragraph:
[0466] The algorithm in place on the golf carts operates in the following manner. When the algorithm detects that the golf cart has entered the zone of a tee box associated with the current hole being played, the play timer is started. The algorithm then waits for the golf cart to enter the green zone of such current hole and for the cart to remain in that zone for a predetermined minimum period of time, for example, 15 seconds. This time period must be long enough to prevent it from being exceeded by simply driving the cart through the green zone, but it must be shorter than the minimum time required to putt. After the cart spends the required time in the green zone, the algorithm expects the cart to enter the tee zone of the next subsequent hole. When this occurs, the play timer for the hole is stopped and a timer for the next hole is started. Additionally, the cart transmits the time of the completed hole to the course management system.

Detail Description Paragraph:
[0469] Referring to FIG. 25, a display on the color monitor 54 of CMC 41 illustrates the times for the current hole being played, the completed holes, and the cumulative time for the round for each active golf cart. The cart (car) number is shown on the left side of the display, the times for each hole played are shown to the right of the cart and target time for each hole is shown along the top. At the far right of the display, the total round time, the target time for the holes played and the time behind or ahead of the target time is shown. When hole or round times exceed the target play times, the cart symbols on the map can be highlighted or the colors for that display can be changed thereby allowing the operator to quickly identify slow playing carts.

Detail Description Paragraph:
[0472] Cost effective color display sunlight readability is one of the most difficult technical problems today. However, the PROLINK system provides an unique technique for providing high resolution color graphics with sunlight readability. To accomplish this feature, the PROLINK system is located in the roof of a golf cart. Such a roof location provides unobstructed access to the PROLINK system while at the same time making the system non-intrusive to the golfer by preserving the fill 360.degree. field of view of the golf course from the golf cart. More importantly, the roof mounted design provided shade for the color monitor so that the golfer was not viewing the display with a bright sunlight background.

Detail Description Paragraph:
[0473] Additionally, the underside of the golf cart roof is colored black and has a diffuse coating for scattering light. The color black significantly improves the

effective display contrast while the diffuse coating significantly reduces the reflectivity of the roof underside.

Detail Description Paragraph:
[0474] Moreover, referring to FIG. 26, screen 47 of color monitor 19 is canted back by a predetermined angle (.alpha.), for example, 7.5.degree., by the bezel that surrounds the screen such that the screen is titled away from the golfer. This requires an angle of incidence of a light ray entering the golf cart to be near horizontal for the light ray to reflect off the display and into the golfer's eyes. The likelihood of a near horizontal light ray is very small compared to the likelihood of a light ray coming in at a different angle. Accordingly, this results in substantially reduced glare.

Detail Description Table CWU:
1 Base Packets Packet Identification Packet Function Broadcast Rate 00.sub.hex2 Differential GPS 1 Hz 01.sub.hex Text Message As Required 02.sub.hex Pin/Tee Box Placement 1 hole each 16 sec 03.sub.hex Network Control 1 time each 4 frame cycles minimum or on channel/ size change. 04.sub.hex Roving Unit Control As Required 05.sub.hex System Data As Required

Detail Description Table CWU:
2 Roving Unit Packets Packet Identification Packet Function Broadcast Rate 00.sub.hex Roving Unit State Depends on Network Size 01.sub.hex Extended Status When required only 02.sub.hex Speed of Play When required only 03.sub.hex Distance travelled/On Time

Detail Description Table CWU:
3 Byte C Language Type Byte Identification Range 0-1 unsigned short bit synchronization BFFF.sub.hex 2 unsigned char message identification 40.sub.hex-7F.sub.hex 3-4 unsigned short number of message bytes 0000.sub.hex - FFFF.sub.hex 5 unsigned char header error detection 00.sub.hex-FF.sub.hex 6 unsigned char first packet identification 00.sub.hex-FF.sub.hex -- -- -- -- -- -- -- -- -- unsigned char second packet identification 00.sub.hex-FF.sub.hex -- etc.

Detail Description Table CWU:
4 Packet 0 - DGPS C Language Byte Type Byte Identification Range 0 unsigned packet identification 80.sub.hex or char 00.sub.hex 1 N/A start of header sub packet -- -- 6 N/A end of header sub packet 7 N/A start of first sub packet defined in header (length = i) -- -- -- -- -- -- -- -- 7 + i - 1 N/A end of first sub packet defined in header (length = i) 7 + i N/A start of second sub packet defined in header (length = i) -- -- -- -- -- -- -- -- 7 +2 * i - 1 N/A end of second sub packet defined in header (length = i) -- -- -- -- -- -- -- -- -- -- -- -- 7 + N * i N/A start of N.sup.th sub packet defined in header (length = i) -- -- -- -- -- -- -- -- 7 + (N + 1) * i N/A end of N.sup.th sub packet - 1 defined in header (length = i)

Detail Description Table CWU:
5 Byte C Language Type Byte Identification Range 0-1 unsigned short sub packet type/number of fol- 0000.sub.hex - lowing sub packets FFFF.sub.hex 2-3 unsigned short modified Z-count/station health 0000.sub.hex - FFFF.sub.hex 4 unsigned char error detection 00.sub.hex - FF.sub.hex

Detail Description Table CWU:
8 Byte C Language Type Byte Identification Range 0 unsigned char scale factor/UDRE/SV ID 00.sub.hex-FF.sub.hex 1-2 short pseudo range correction 0000.sub.hex- FFFF.sub.hex 3 short range rate correction 00.sub.hex-FF.sub.hex 4 unsigned char issue of data 00.sub.hex-FF.sub.hex 5 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
9 Bits Function 7 pseudo range/range (0: PR = 0.02 m, RR = 0.002 m/s) rate scale

h e b b g e e e f c e e ge

factor (1: PR 9.32 m, RR 0.032 m/s) 6-5 UDRE 00.sub.binary - 1.sigma. .ltoreq. 1 meter 01.sub.binary - 1 meter < 1.sigma. .ltoreq. 4 meters 10.sub.binary - 4 meters < 1.sigma. .ltoreq. 8 meters 11.sub.binary - 1.sigma. > 8 meters 4-0 SV ID range = 1 to 32, where 32 = 00000.sub.binary

Detail Description Table CWU:
10 Byte C Language Type Byte Identification Range 0 unsigned char SF/UDRE/SV ID 00.sub.hex-FF.sub.hex 1-2 unsigned char delta pseudo range correction 0000.sub.hex-FFFF.sub.hex 3 short delta range rate correction 00.sub.hex-FF.sub.hex 4 char issue of data 00.sub.hex-FF.sub.hex 5 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
11 Byte C Language Type Byte Identification Range 0-2 N/A constellation health 000000.sub.hex- FFFFFF.sub.hex 3 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
12 Bits Function 23-19 Satellite ID: SV ID range = 1 to 32 and where 32 = 00000.sub.binary 18 Issue of data link: 0 indicates this information refers to nav data with LOD in ty 1 or type 9 message. 1 indicates this information refers to nav data with IOD in type 2 message 17-15 Data health: see table 20-VII of ICD-GPS-200 14-9 Carrier to noise ratio: sf = 1dB/Hz, range = 25 to 56, LBS is bit 13 8 Health enable: if 1, SV is healthy even though SV nav data indicates unhealthy 7 New navigation data: new SV nav data is being collected that will soon result in new IOD for the type 1 message 6 Navigation data warning: a 1 indicates a problem in SV nav data 5 Loss of satellite warning: if i then SV is-scheduled to be switched to unhealthy 4-2 Time to unhealthy: if but 17 is set, then bits 18-21 define how much time until SV is set unhealthy. LSB = 5 minutes. Range is 0 to 80 minutes 1-0 spares

Detail Description Table CWU:
13 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 01.sub.hex 1 unsigned char cart address 00.sub.hex-FF.sub.hex 2 unsigned char issue of data message 00.sub.hex-FF.sub.hex 3 unsigned char number of frames for message/ 00.sub.hex-FF.sub.hex current frame number 4 unsigned char ASCII character 1 00.sub.hex-FF.sub.hex 5 unsigned char ASCII character 2 00.sub.hex-FF.sub.hex 6 unsigned char ASCII character 3 00.sub.hex-FF.sub.hex -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 27 unsigned char ASCII character 24 00.sub.hex-FF.sub.hex 28 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
14 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 02.sub.hex 1 unsigned char hole number 00.sub.hex-FF.sub.hex 2-3 short pin X position (LSB = 8000.sub.hex-7FFFF.sub.hex 2.sup.-3) (2.sup.+5 complement for) -4096 m-4095.875 m 4-5 short pin Y position (LSB = 8000.sub.hex-7FFFF.sub.hex 2.sup.-3) (2.sup.+5 complement for) -4096 m-4095.875 m 6 unsigned char front tee/front-middle 00.sub.hex-FF.sub.hex tee 7 unsigned char back-middle tee/back 00.sub.hex-FF.sub.hex tee 8-9 unsigned short packet checksum 0000.sub.hex-FFFF.sub.hex

Detail Description Table CWU:
15 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 03.sub.hex-83.sub.hex 1-2 unsigned short GPS week since Jan 6, 0000.sub.hex- 1980 FFFF.sub.hex 3-4 unsigned short seconds in the week since 0-604,800 s midnight Saturday (LSB = 10 seconds) 5 unsigned char frequency / network status 00.sub.hex-FF.sub.hex 6 unsigned char current number of frames / 00.sub.hex-FF.sub.hex new number of frames 7 unsigned char network frame counter 00.sub.hex-FF.sub.hex 8 unsigned char network duty cycle control 00hex-FF.sub.hex 9 unsigned char spare 00.sub.hex 10, 11, 12 unsigned char error detection 000000.sub.hex-

h e b b g e e e f c e e ge

FFFFFF.sub.hex

Detail Description Table CWU:
16 Bits Function 0-3 bits 0-3 = 0.sub.hex -- > network continues operating in its previous state bits 0-3 = 1.sub.hex -- > halt network (rogues immediately cease transmitting) bits 0-3 = 2.sub.hex -- > restart network (rogues immediately begin transmitting in their time slots defined by bytes 16 and 17 conditioned by byte 18 - duty cycle) bits 0-3 = 3.sub.hex -- > station identification to follow bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = F.sub.hex -- > Spare 4-7 bits 4-7 = 0.sub.hex -- > tune to channel 0 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = F.sub.hex -- > tune to channel 15

Detail Description Table CWU:
18 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 04.sub.hex or 84.sub.hex 1 unsigned char cart address 01.sub.hex-FF.sub.hex 2 unsigned char re transmit control / current 00.sub.hex-FF.sub.hex frame 3 unsigned char transmit frame number / total 00.sub.hex-FF.sub.hex number of frames 4 subframe/spare 0-F 5 spare 0 6-7 unsigned short error detection packet check 0000.sub.hex- sum FFFF.sub.hex

Detail Description Table CWU:
20 Byte C Language Type Byte Identification Range 0 unsigned char packet id 0.times.05 1 signed char time zone offset 2's complement .+-. 50 (LSB = 900 seconds) (.+-. 14 hours) 2-7 -- spares 0 8-9 unsigned short error detection 0000-FFFF

Detail Description Table CWU:
21 Byte C Language Type Byte Identification Range 0-1 unsigned short bit synchronization BFFF.sub.hex 2-3 unsigned short message / packet identi-00.sub.hex-3F.sub.hex fication 4 -- packet contents -- -- -- -- -- -- -- -- -- -- 8 -- end of packet --

Detail Description Table CWU:
22 Bits Function 15 1 - terminate bit synchronization properly 14-7 Message identification byte (same as rogue ID or address) 00.sub.hex - no definition 01.sub.hex - cart 1 02.sub.hex - cart 2 03.sub.hex - cart 3 03.sub.hex - cart 3 03.sub.hex - cart 3 03.sub.hex - cart 3 FF.sub.hex - cart 255 6-4 00.sub.hex - packet 0 01.sub.hex - packet 1 02.sub.hex - packet 2 02.sub.hex - packet 2 07.sub.hex - packet 7 3-0 error detection

Detail Description Table CWU:
23 Byte C Language Type Byte Identification Range 0 unsigned char rogue status 00.sub.hex-FF.sub.hex 1-3 N/A rogue position 000000.sub.hex- FFFFFF.sub.hex 4 unsigned char packet error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
26 Byte C Language Type Byte Identification Range 0 unsigned char cart status 1 00.sub.hex-FF.sub.hex 1 unsigned char cart status 2 00.sub.hex-FF.sub.hex 2 unsigned char cart status 3 00.sub.hex-FF.sub.hex 3 unsigned char cart status 4 00.sub.hex-FF.sub.hex 4 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
27 Byte C Language Type Byte Identification Range 0 unsigned character rogue status 00.sub.hex-FF.sub.hex 1 unsigned character rogue statues byte with hole C1.sub.hex-F6.sub.hex code set 2 unsigned character score: player 1 in low nibble, 00.sub.hex-FF.sub.hex player 2 in high nibble; Score range is 1-15 0 = no score data 3 unsigned character hole play time - LSB 10 sec 00.sub.hex-FF.sub.hex 4 unsigned

h e b b g e e e f c e e ge

character error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
28 Byte C Language Type Byte Identification Range 0 unsigned char rouge status 00-FF 1-2 unsigned char distance traveled (LSB = 1 0000-FFFF meter) 3 unsigned char PROLINK on-time (LSB = 300 00-FF sec) 4 unsigned char error detection 00-FF

L4: Entry 9 of 25 File: USPT Sep 23, 2003

DOCUMENT-IDENTIFIER: US 6625539 B1
TITLE: Range prediction in fleet management of electric and fuel-cell vehicles

Brief Summary Text (5):
In U.S. Pat. No. 5,904,727 to S. Prabhakaran teaches mapping of fleet vehicle locations at a remote base station using a graphical display. The display also indicates identification, motion status, including speed, nearest intersection and destination. Jobs are assigned to vehicles based upon an evaluation by a fleet manager at a base station.

Brief Summary Text (8):
Parview Systems makes golf carts having a processor board, made by Applied Telematics of Columbia, Md. with a GPS chip and a video display. The display shows the position of the golf cart, as well as a map of a hole being played and the distance to the hole. The system is similar to one described in international patent document WO 93/12439 in the name of T. Gunthorpe et al. The Parview golf cart may be seen on the website ww.applied-telematics.net. The circuit board features an Intel 206 MHz StrongARM SA1110 processor, according to the website, along with power management for the board and flat panel display drivers. With power management, the board takes less than 2 watts at full operation, and has an automatic idling feature that suspends power to the display when the cart is not in active use. The system has three serial ports that are allocated to GPS, radio connections, and one is a spare for future expansion. Other functions implemented on the single-board computer include PCMCIA, a Codec, digital I/O, and analog inputs.

Brief Summary Text (12):
The present invention is a method for determining range relative to a dynamic GPS position of each vehicle in a fleet of electric and fuel cell vehicles and using this information for optimizing vehicle dispatch in real time. Each vehicle periodically reports power pack parameters, particularly remaining voltage sag and remaining voltage. GPS position and other parameters are also reported to a base station where a central computer records the information into a database and displays information to a dispatcher using a graphical user interface (GUI). The dispatcher can then interpret the information and either assign future tasks or direct vehicles for refueling or maintenance. Each vehicle has parameter collecting and reporting instrumentation, such as an odometer reader and a power pack stored energy reader that include other key power cell parameters such as cell temperature, voltage sag, individual cell voltage, as well as a GPS sensor and reader, all reporting data to a base station via a wireless network. The network may use an existing voice channel radio link, a separate dedicated radio link for the network, or a virtual private network using the Internet. Existing smart batteries and fuel cells already report remaining charge to dashboard instruments in vehicles being sold today. This information may be used as the power pack charge reader. Vehicular GPS sensors with display capability have been sold for several years. At the base station, position data and power cell data, such as remaining stored charge, are continuously monitored and fed to a database which also contains range calibration data for each vehicle. This allows the computer to predict remaining range based upon remaining stored energy by comparison to the calibration data for each vehicle. The database may also contain static information, such as

the time that the vehicle driver started work and his or her scheduled quitting time. Basic vehicle information, such as identification, as well as present position and remaining range can be displayed to a dispatcher on a map for new job assignments. The dispatcher can click on a particular vehicle on the map to see details in the database regarding reported parameters.

Detailed Description Text (2):
With reference to FIG. 1, a vehicle 11 is shown, powered by a non-petroleum power pack 13, such as batteries or a fuel cell. The vehicle may be small, such as golf cart size or may be large, like a truck. The power pack 13 supplies stored energy, preferably stored chemical energy in a form of a battery or fuel cell. The energy is used to drive a motor of which, in turn, transfers power to automotive propulsion components.

Detailed Description Text (8):
With reference to FIG. 2, three data items are shown to be reported to database 61. These three items are exemplary and in other information can be transmitted as well. Static information is transmitted, such as vehicle identification, shown in block 71. The second data item is the reported GPS present position coming from the GPS module on the telematics circuit board. This is shown in block 73. Another data item is the remaining stored charge or power pack parameters, shown in block 75. These are also reported to the database. All the reported information is transmitted wirelessly to the data module 47.

Detailed Description Text (12):
FIG. 4 has representative database data. In the first row, vehicle identification and time of day is shown. The vehicles are identified as N1, N2, N3, N4 and N5. Each vehicle is known as a certain type of vehicle, such as a golf cart, van or truck. The state of charge of each vehicle is indicated in the row showing full charge kW-hrs. Output amps are also shown and might depend not only upon current drawn by the motor but also by the accessories. The voltage reading of each cell is shown in the successive rows. The GPS coordinates and radio state are shown in the next three rows. In the following rows, the temperature of each cell is shown. Abnormally hot or cold temperatures would indicate a maintenance condition. Other vehicle data, such as a busy condition and whether lights are on may be also shown. Note that not all of the database data from FIG. 4 needs to be employed against one of the tables contained in FIG. 3, depending on vehicle load, i.e. mileage efficiency, as previously described. Only remaining energy level is used to determine range using the model once the proper table or combination of tables is selected. Tables may be combined by selecting different combination of complementary data tables at different times as mileage efficiency changes. In this manner, mileage efficiency can be calculated and integrated over time. Yet, other information is available in the database. The other information may be recalled by clicking on an icon of a selected vehicle on the map mentioned above. By clicking on the selected vehicle, the display is switched to a view of database parameters for the particular vehicle selected.

Detailed Description Text (13):
In this manner, a dispatcher has access to all vehicle information if investigation of a particular condition is desired. Dispatch may be automated by allowing the computer to select a vehicle available for a job request. The computer would make its assignment based on an optimized routing heuristic that includes remaining vehicle range as a constraint.

CLAIMS:

8. A method of managing electric and fuel cell vehicles in a fleet comprising: collecting charge data in each vehicle while each vehicle is in use; comparing in each vehicle, while in use, the charge data to calibration data considering changing mileage efficiency for establishing remaining range in each vehicle;

determining GPS position of each vehicle, reporting the remaining range and the GPS position of each vehicle to the base station computer; and dispatching vehicles from reported GPS positions using remaining range as a constraint in an optimized routing heuristic.

h e b b g e e e f c e e ge

First Hit

End of Result Set

Generate Collection Print

L4: Entry 25 of 25 File: DWPI Aug 23, 2001

DERWENT-ACC-NO: 2002-226290
DERWENT-WEEK: 200228

TITLE: Map-matching golf navigation system with Kalman filter for correction and optimization

Basic Abstract Text (1):
NOVELTY - Golf cart is equipped with a computerized navigation system based on the features of interest on hole of a golf course including tee-boxes, cups, water hazards, sand traps, rough areas adjacent fairway and cart path. DR calibrator compares the DR navigation solution to map-matched data and corrects the errors in the DR solution to provide accurately calibrated DR navigation system. The essence of the correction and calibration technique is the formulation of a correction gain computation and the number of DR sensor errors to be calibrated. The preferred approach is to use a Kalman filter but other optimal and sub-optimal estimation methods may be employed as alternatives.

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TITLE: Golf course yardage and information system having improved zone information and display characteristics

Summary of Invention Paragraph:
[0007] Huston proposed a golf course GPS system which employs purely conventional differential GPS, which has found wide use to reduce errors in distance measuring systems. The differential GPS (DGPS) system broadcasts error correction information from a ground receiver of known location in the vicinity of the user. Two GPS receivers are used, one at a known fixed position, so that the difference between that known position and its position calculated from the satellite GPS signal fixes the error in the signal. The fixed position (reference) receiver provides a continuous correction for use by all other receivers, which may be mobile, within its reception area. Knowledge of the error allows all distance and position calculations at the user's receiver to be corrected. Conventional DGPS can reduce errors in position calculations to allow accuracies of within about five meters quite suitable for most commercial needs, but still unacceptable for a golf course distance measuring system. However, the same conventional DGPS system may be used to determine the location of a golf cart receiver relative to the pin on a hole of a golf course as to determine the location of a ship relative to a land-based point of interest. Weather conditions and terrain have little effect on position determination in the GPS system, and few restrictions are imposed on size or location of a user's receiver.

Summary of Invention Paragraph:
[0015] Another object of the present invention is to provide such a system having the capability of detecting when the golf carts are within predetermined zones or regions of the golf course for use in unique system features such as automatic display of the current hole on the monitor of each golf cart, measuring the pace of play for each hole, and automatic pop-up advertisements on the monitor of each golf cart as the carts transition from one hole to the next.

Summary of Invention Paragraph:
[0016] Another object of the present invention is to provide an improved technique and method for mounting a monitor to the roof of a golf cart for exceptional color readability in sunlight.

Summary of Invention Paragraph:
[0018] The PROLINK system includes a golf cart-based subsystem, although it may be packaged alternatively or additionally into a hand-held unit carried by the golfer. Both such versions are included within the generic terminology of a mobile unit, a portable unit, or a roving unit. Each roving unit utilizes state-of-the-art DGPS technology, with considerable enhancement by the features and aspects of the present invention, incorporated in hardware and software.

Summary of Invention Paragraph:
[0026] The course management portion of the PROLINK system includes a base station computer unit, receiver/transmitter unit and video monitor in the clubhouse (or other desired location) to give the course administrator better insight into daily operations and revenues. Principal advantages of the course management portion

include (1) the capability to identify, locate and monitor movement of every golf cart on the course in real-time, with precise positioning during play on each hole, (2) use of that knowledge to pinpoint location and analyze cause of bottlenecks, toward improving speed of play, and greater enjoyment by all players, (3) compilation of an extensive computerized data base to provide management and designated staff personnel with accurate statistical insight into course operations and techniques for instituting improvements, and (4) availability of a convenient source of communication and messaging to all roving units, with potential concomitant revenue enhancement through advertising and promotions.

Summary of Invention Paragraph:
[0028] The size of a golf course's ranger staff may be reduced by virtue of having a wealth of information available to the course administrator from the PROLINK system. Despite their fewer number, the rangers may be used more efficiently by dispatching them to precise locations where bottlenecks or other barriers to efficient play are occurring. Each roving unit is assigned a unique ID number which is transmitted by the system for periodically monitoring (and displaying) (e.g., every 2 to 16 seconds, depending upon the number of carts on the course) each unit during play, for identifying selected golfers for messages, or those who may be causing problems, or for other purposes.

Summary of Invention Paragraph:
[0030] The PROLINK system also employs a unique technique and method for collecting data indicative of the layout of the golf course including such features as tee boxes, greens, fairways, water hazards and sand traps. Such collected data is then post-processed and efficiently stored in memory in vector form for later retrieval and display. Moreover, once the data representing the golf course is stored in memory, such data can be used to efficiently determine the location of a golf cart relative to predetermined zones or regions. To that end, the PROLINK system utilizes a unique zone detection algorithm and creates a number of different zones corresponding to actual areas or objects on the golf course. For example, zones are created corresponding to a tee box area or a green area of a particular hole on the course. Accordingly, the PROLINK system has the capability to detect a golf cart to be within an actual area on the golf course when the coordinates of the golf cart lie within the corresponding zone.

Summary of Invention Paragraph:
[0031] By the use of such a zone detection algorithm, various features of the PROLINK system are readily implemented. Such features include automatic hole display on the cart monitor as the cart enters the tee box zone of a new hole, and automatic pop-up, high resolution, color advertisements when the cart is in transition from one hole to the next. Additionally, the speed of play for a hole may be obtained by measuring the time from when a golf cart enters the tee box zone of a hole to when the cart exits the green zone of that hole.

Brief Description of Drawings Paragraph:
[0059] FIG. 26 is a pictorial diagram illustrating the mounting of a monitor to the roof of a golf cart for promoting enhanced sunlight readability.

Detail Description Paragraph:
[0060] Referring to FIG. 1A, a presently preferred embodiment of the PROLINK system includes a base station 10 (sometimes referred to as the course management station, or CMS) located at a convenient place on the golf course premises such as in the clubhouse (preferably, in the pro shop). The CMS includes a computer (sometimes referred to herein as the course management computer, or CMC). The present invention also includes software to be described hereinafter for execution by the CMC. A related GPS receiver 11 (a Navstar XR5-M6 GPS receiver in the preferred embodiment) receives transmissions from GPS satellites such as 14, and a transceiver 12 provides two-way radio frequency (RF) communication with a multiplicity of mobile receivers which may be cart-based (as at 15) or hand-held

units (handsets, not shown). From time to time, the mobile units will be referred to herein as roving units. In the preferred embodiment, each roving unit is cart-based, i.e., installed on its own golf cart 16, but could be a hand held unit, if desired.

Detail Description Paragraph:
[0063] The monitor 19 is shown in somewhat more detail in FIG. 1C. It is mounted at the underside of the roof 20 of golf cart 16, and is turned on (together with the other electronics in the cart-based unit) at the time the cart is checked out from the course cart shop. Except for an advertising display presented prior to play and between holes, the monitor normally displays the layout of the hole being played, and this is done automatically (as the default display) as the cart approaches within a predetermined distance of the tee boxes for the hole. Alternatively, the user (typically, the golfer playing the course, although maintenance people and others may at times use the cart) may select some other option at any particular time by operating keypad control buttons 23 on a control panel mounted just under the monitor in the cart roof. The components of cart-based PCU 16 will be described in more detail later.

Detail Description Paragraph:
[0065] The golf carts in which the roving units are installed are normally garaged at a course cart shop when not in use. The cart attendant, who obtains identification from each golfer/renter at the time the cart is checked out, may record this information for subsequent entry of the golfer's name and the ID number of the respective cart into CMS 10 for correlation purposes. With this information available for instant readout, any personal messages that may need to be directed to a player during a round of golf can be communicated to that player's cart anywhere on the course.

Detail Description Paragraph:
[0070] Information transmitted from the CMS 10 to each CBU 15 includes DGPS corrections for CBU computation of position, velocity, and distances. Also, network control data provides essential timing information for the base station/cart communications, messages, dynamic object status (such as pin placements and tee box locations), initialization message with time and position data to `cold start` the CBU GPS receivers if required, and golfer names and start times information for the course rangers. Information supplied by each CBU to the CMS includes the location of each golf cart by ID, message information from the golfers, pace of play data and player score and statistics information for post-play output.

Detail Description Paragraph:
[0072] The course management portion of the system performs various functions beyond those already mentioned. For example, a high resolution color computer monitor displays the course map with all its features, and indicates on the map the locations of the individual roving units on the course including golf carts, refreshment carts, and maintenance carts, updated in real time as the carts move about the golf course. A zoom feature allows enlargement of any area of the map of interest, such as a particular hole or a number of contiguous holes. Pop up windows may be engaged by the CMS operator to execute any of several actions, such as a global message for distribution to the golf carts. Advertising and promotional messages, such as the day's lunch special, sports scores, identity of a golfer who hit the longest drive in a scramble, and personal messages may be sent to the carts. Also, the course management portion provides overall system timing, and master control of the PROLINK system communications network.

Detail Description Paragraph:
[0074] BRIU 37 includes a GPS subsystem 42 with antenna 43, a primary PROLINK computer unit (PCU) 44 with antenna 45 for transmitting and receiving data packets to and from each of the carts, a secondary PROLINK computer unit (PCU) 51 with antenna 52 for monitoring frequencies before transmission and for broadcasting a

station identification to assure compliance with the Federal Communications Commission regulations,, and interface converter 53 for providing an interface between BRIU subsystem 37 and CMC 41. BPIU 37 may optionally include a relay PROLINK computer unit 55 for courses with particularly harsh terrain that may not be line-of-sight with the BRIU to assure reliable radio communication.

Detail Description Paragraph:
[0078] CMC 41 serves as the master control for the entire PROLINK system. It may, for example, be an IBM-compatible 486-based 66 MHz PC (personal computer) with 8 megabytes (MB) of RAM (random access memory), an 200 MB hard drive, and extended graphics capability with a local bus video system, a video accelerator high-resolution card having 1024 pixels vertical resolution and 1280 pixels horizontal resolution, and nominally 256 colors. In addition to its capabilities described above, this computer enables asset (e.g., golf cart-based units) management by the course administrator. The course digital map display 54 is preferably a color video (computer) monitor with 17- to 21-inch screen size.

Detail Description Paragraph:
[0084] Modem 48 allows play speed and other course utilization data and overall system operational data to be downloaded from the computer. The latter data include the status of each cart-based unit 15, such as a need for emergency repair following a breakdown. Similarly, the modem allows data to be loaded into the computer, such advertising matter to be sent to the carts for display. The system may be implemented to allow a PROLINK maintenance provider to call into the system for remote extraction of information concerning system performance history since the last review, and to load new software upgrades into the PROLINK system. The modem may also be used to allow players in other cities or course owners to preview the course on which the system is installed, by observing course features and actual play in progress, in anticipation of playing the course during an upcoming visit. Conventional security measures may be invoked by the user course or by the system supplier to limit system user access to certain functions and information.

Detail Description Paragraph:
[0085] Each cart with a roving unit is assigned an ID number to be incorporated in the header of a message packet for communication with the golfer(s) who rented the cart. Correlation of golfers with carts is performed by entering data into the CMC 41 by an attendant at the time of cart checkout. On completion of play of the round, the CMC may be activated by a trigger signal when the cart departs from the 18th hole, or by manual selection, to compile the stored data for the individual player's statistics for that round, including drive distance on each hole, score for each hole and total score, play times, and so forth. This statistical data is then available to the course manager and to the golfer in the form of a hardcopy printout or computer disk. As a result, the golfer is able to replay and analyze his or her game at a convenient time at home.

Detail Description Paragraph:
[0088] Upon completion of system initialization, a number of tasks are commenced. Thirty-two (32) hertz (Hz) task 62 when activated sends out morse code data to enable the secondary PCU 51 to broadcast the station identification on the RF communication channel that CMS 10 is currently operating on.

Detail Description Paragraph:
[0099] Another significant aspect of the system software according to the invention is the use of a windowing graphical user interface which is tailored to support real-time operating systems by requiring only relatively little CPU throughput for operation. The graphical user interface utilizes on-screen windows that contain important information to the particular user, and is employed on both the golf cart mobile unit display and the course management display.

Detail Description Paragraph:

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[0104] The PROLINK system has the capability to send information bi-directionally between the clubhouse base station and the golf cart roving units. The CMC must send a significant amount of information to the roving units, such as differential GPS corrections to assure that the carts have very accurate yardage information, personal and global messages to golfers, pin placement and tee box location updates to golfers on the course, and so forth. Similarly, the mobile units need to send information to the CMC such as the state of the course, the cart position, time of play for a given hole, general information or requests from golfers such as to send the refreshment cart and so forth.

Detail Description Paragraph:
[0128] The PROLINK system provides command and control with bi-directional communications between a commander (the PROLINK base station) and a plurality of control assets (individual roving units, such as PROLINK-based golf cart). In the presently preferred embodiment, a variable length packet network is used for communications, in which digital messages containing data packets are transmitted between the base station and the roving units in a half duplex Time Division Multiplex (TDM) digital communication system. Each communication message may be a single packet or multiple packets, but available channel bandwidth is maximized by putting as many packets as can be accommodated in each message.

Detail Description Paragraph:
[0129] Each message has a message identification header. In general, bit synchronization information is provided at the beginning of each message, but long messages may also contain synchronization information in the middle or at the end of the message. Each packet has an identifier uniquely determinable from other packets in the message, and is embedded with error detection mechanisms.

Detail Description Paragraph:
[0140] No interruptions of a frame or a frame cycle are allowed in mid-execution. Rather, all interruptions in frame broadcast are restricted to the beginning of an integer second at the beginning of the frame cycle. The base is responsible for timing interrupts accordingly through the use of base packet 3 (network control). On reception of network reconfiguration commands in base packet 3, all carts must wait until the end of the frame cycle before enacting the configuration change command. Examples of frame interrupts are (i) preparation for a station identification broadcast, (ii) a network reconfiguration, and (iii) network duty cycle control.

Detail Description Paragraph:
[0165] In the PROLINK system, the network configuration will be required frequently during normal network operations. Activities such as entry of additional carts into the network, transitioning channels and embedding a transmit/receive duty cycle to meet shared channel requirements, and station identification broadcasts, among other possibilities, necessitate network configuration changes.

Detail Description Paragraph:
[0177] When a change of channel is decided, the base maintains the upper nibble of byte 5 set to the new channel over the entire frame cycle so that all carts are notified. Once a channel change is declared, it is not subject to change in mid-cycle, which means that a problem could erupt if a shared channel user were to usurp the channel in a frame cycle period and find that the entire network is displacing it on the selected channel at the end of the first frame cycle. To avoid this, however, PCU 51 transmits a Morse Code station identification on the new channel immediately after the channel change has been declared and for that entire frame cycle, so that the PROLINK system immediately "claims" the new channel when it is available, and satisfies the FCC identification requirement.

Detail Description Paragraph:
[0183] Network Station Identification

Detail Description Paragraph:
[0184] FCC rules require that the base broadcast a Morse code station identification at least once every 15 minutes. This is done automatically by the scanning receiver just before every network channel change when the new channel is claimed, after an old channel is left, and during duty cycle off periods.

Detail Description Paragraph:
[0217] The base message consists of a bit synchronization word (16 bits), a message identification byte (8 bits), a number of message bytes, a header error detection byte, and packets, as defined in the following Table.

Detail Description Paragraph:
[0219] A Motorola 68332 Time Processor Unit (TPU) is used for bit synchronization. To support TPU detection of bit synchronization, the bit sync word is BFFF.sub.hex, and the most significant bit (MSB) of the message identification byte must be low. Also, a selected bit, for example bit 14, of byte 2 is chosen to be high to distinguish a cart-based message from a base station message. Thus, a maximum of 64 (7F.sub.hex-40.sub.hex) messages may exist. Details of bit synchronization are discussed below.

Detail Description Paragraph:
[0222] Each base packet has a common structure with unique contents to support software commonality. The common structure is a header byte in the byte 0 packet position, and an error detection word or words as the last four bytes in the packet. The MSB of the header byte may be set to request an acknowledge from the receiving rogue(s), so that up to 128 unique packets can be transmitted from the base to the rogues. For example, a packet identification of 81.sub.hex is identical to 01.sub.hex to the receiving rogue except the 81.sub.hex case requires a hard "acknowledge" from the rogue while an 01.sub.hex does not. A total of 6 base packets is used in the preferred embodiment, viz., (1) a DGPS packet, (2) a text message packet, (3) a pin/tee box placement packet, (4) a network control packet, (5) a rogue control packet, and (6) a system data packet. The contents of these packets are defined below.

Detail Description Paragraph:
[0230] The packet identification byte (0) for the DGPS packet is 0, by definition. An 80.sub.hex requires the rogue to acknowledge the successful receipt of the packet; a 00.sub.hex does not. The data sub packet is of length i, determined by the rogues from the sub packet type defined in the header sub packet, and N data sub packets of the same type are included in one DGPS packet. The DGPS packet is the only packet that does not have error detection since there is adequate error detection on all sub packets.

Detail Description Paragraph:
[0235] The sub packet type is equivalent to the RTCM-104 message type (frame ID).

Detail Description Paragraph:
[0245] Byte 0 contains a pseudo range/range rate scale factor, User Differential Range Error (UDRE), and satellite identification, as shown in the following Table.

Detail Description Paragraph:
[0259] The text message packet enables the course manager to send a common message to all roving units (golf carts), or to send specific messages to any individual golf cart. A common message, for example, might be the score of a game, a lunch special, or other information which the course manager desires to transmit to all active carts. A unique message to a specific cart might be warnings regarding unauthorized behavior (e.g., driving the cart on the green), or a message from a business associate. Up to 24 characters can be transmitted at one time in a packet; however, up to 16 frames of the packet can be transmitted, which allows a total

message length of 384 characters including punctuation and spaces (amounting to about five full text lines). The roving units do not display any part of the message until all frames have been received successfully. At that time the entire message is displayed in a pop up window.

Detail Description Paragraph:
[0262] The packet identification (byte 0) for the text packet is 1. A cart address (byte 1) of 00.sub.hex is the all call address and is set if it is desired for all carts to receive a transmission. Any other address will communicate only with the specific cart number identified by the address, and with no other carts on the course.

Detail Description Paragraph:
[0268] The pin/tee box placement packet is preferably assigned the lowest order of packet transmission priority, which is to say that if a base message has no space available, broadcast of the pin/tee box placement packet may be deferred to a subsequent frame in which space is available. Partly for that reason, although the 18 packets should be periodic on 16 second intervals, they may be distributed in any desired sequence throughout the 288 second interval to optimize message loading. This particular packet structure is defined in the following Table.

Detail Description Paragraph:
[0270] The packet identification (byte 0) is 2, by definition. The hole number (byte 1) can range theoretically from 1 to 255 with an 8-bit byte, although nothing beyond coverage of a 54 hole course would be required as a practical matter. The pin position for the hole is precisely indicated by bytes 2-3 and 4-5, while bytes 6-7 indicate all tee box locations. For instance, the upper nibble of byte 6 contains the tee box number that is the active front tee box, and the lower nibble of byte 6 contains the tee box number that is active in the front-middle position. Similarly, the upper and lower nibbles of byte 7 indicate active back-middle and active back (championship) positions of the respective tee boxes.

Detail Description Paragraph:
[0275] The packet identification (byte 0) is 3. An 83.sub.hex requires the cart to acknowledge successful receipt of a packet, whereas an 03.sub.hex requires no acknowledgement. The Rockwell Navcore V GPS engine receives its initialization data from the network control packet (bytes 1-4) as shown in the above table. The GPS time (bytes 1-4) is broadcast in a different format from that required by the Rockwell Navcore V, to save bandwidth. The GPS week (bytes 1-2) started (week 0) on Sunday morning, Jan. 6, 1980. Bytes 34 contain the number of seconds since the beginning of the GPS week scaled at 10 seconds per bit. The CPU card should reformat the time data to that required by the Navcore V. In addition to time, the GPS engine needs the initial position for rapid acquisition. Since each cart has the defined location of the origin of the course map coordinate system in memory to support course reference frame positioning, this latitude, longitude and altitude can be used to initialize the GPS engine.

Detail Description Paragraph:
[0281] Network duty cycle is to provide off time for compliance with the FCC shared channel rules and to ensure there is an off time available for transmission of the channel id Morse code signal. The most significant 5 bits of byte 8 (bits 7-3) define the network on-time, and the least significant 3 bits define the network off-time. Byte 8 is further described by the Table below.

Detail Description Paragraph:
[0290] The rogue control packet identification (byte 0) is 84, by definition. An 84 00.sub.hex requires acknowledge of the cart's successful receipt of the packet. The cart address (byte 1) is the identification (ID) number assigned by the course administrator to the cart, and ranges from 1 up to 255 carts. Address 00.sub.hex (the "all call" address) is not allowed, because the rogue control packet is only

intended for a specific cart.

Detail Description Paragraph:
[0299] Byte zero is the System Data Packet ID. Byte one is the time zone offset for UTC time for the particular location of the PROLINK system quantized at 15 minute intervals. The time zone information allows accurate display of local time to golfers during their round. Bytes 2-7 are spares for future expansion. Bytes 8 and 9 are the (20,1) code error detection bits with the upper nibble of byte 8 being used for byte 0 and 1 error detection, the lower nibble of byte 8 being used for byte 2 and 3 error detection and so on through byte 7 of the packet.

Detail Description Paragraph:
[0304] The cart message consists of a bit synchronization word (16 bits), a combination message identification and packet identification word (16 bits total), and the actual packets. This format is truncated significantly from the base station format for bandwidth efficiency; however, the messages maintain uniqueness between the base station and the carts for easy identification. The cart messages are an exact fixed length (9 bytes), and the base station uses this information to compute the checksum for error detection. The cart message structure is illustrated in the following table:

Detail Description Paragraph:
[0306] The bit synchronization embedded in the cart messages (bytes 0 and 1 BFFF.sub.hex) is identical to that of the base messages. The message and packet identification are quite different, but are easily separable as follows.

Detail Description Paragraph:
[0308] The MSB of the message/packet identification word must always be low to support bit synchronization. The next 8 bits (bits 14-7) define the cart address, the next 3 bits (bits 6-4) define the cart packet type with up to 8 packets supported, and the last 4 bits support error detection. To prevent confusion with an "all call" address, the cart address cannot be 00.sub.hex.

Detail Description Paragraph:
[0327] The Distance Traveled/On-Time Packet contains the total distance traveled by the golf cart during the round of play. Additionally, the packet contains the total time that the PROLINK system has been on for the round. This packet is only broadcast at the end of each golf round and is defined in detail below:

Detail Description Paragraph:
[0373] Referring now to FIG. 12, in which like reference numbers to those used in FIGS. 1, 2 and 3, for example, refer to like portions of the PROLINK system, a detailed block diagram of the electronic components of cart-based units 15-1 is shown. The GPS data are received by the cart 15-1 from the satellites 14-1, . . . , 14-n, together with data from the base station (course management station) 10 on the course communications network. The cart includes a cart-based unit (CBU) PROLINK Computer Unit (PCU) 16 which is substantially similar to primary PCUs 44 and 51 (of FIG. 4) with the exception that PCU 16 additionally includes a GPS engine (17) while PCUs 44 and 51 utilize GPS subsystem 42 of FIG. 4. Cart-based PCU 16 includes a CPU/video controller card 18, GPS engine 17, digital data transceiver/RF card 22, and power distribution card 24, and interacts with keypad 23 and color monitor 19. Power distribution card 24 is supplied by a cart power interface box 25, which is itself energized by the cart batteries. The color monitor assembly 19 is mounted inside the golf cart below the roof for ease of viewing by the cart occupants without interfering with the driver's view of the cart path. Such mounting of monitor 19 is significant for allowing color readability in sunlight, the details of which will be discussed later. The key pad assembly 23 mounted below the base of the monitor allows ready access by the cart operator. The PCU 16 is embedded in the cart roof, and a cart power interface box 25 is mounted in the cart out of the way of the occupants.

Detail Description Paragraph:
[0377] A Cart Power Interface Box (25) is mounted under the seat of the cart or could alternately be mounted underside of the roof of the cart, alongside PCU 16. As shown in FIG. 12, a pair of wires run from the DC power supply (typically several batteries supplying +36 volts) and the ground reference of the golf cart into the roof assembly and to the cart power interface box. The power interface box converts this unregulated 36v supply to unregulated 15v DC which is used to power PCU 16, and to 120v AC used to power monitor 19. The PROLINK electronics use unregulated 12-15v DC as the primary power source because similar system concepts are applicable not only to the golf market, but to many other markets as well. For example, unregulated 12v power is readily obtained from many types of motor vehicles, tractors, aviation equipment, airplanes, and so forth.

Detail Description Paragraph:
[0390] The CPU provides an external communications interface for maintenance functions to be performed, golf course data or control program instructions to be updated, and any portion of nonvolatile memory to be either examined or updated. User commands are accepted by the CPU from keypad 23 having individual keys and a directional controller, and configured in row and column format that allows each depressed key to be individually identified. The system software enables the function labels for the individual keys to be viewed by the user along the bottom edge of the display, and each of the keys to be redefined by appropriate software programming whenever a new display mode is selected. The directional controller preferably has mouse, trackball, or other device with analogous characteristics that will allow the user to move the cursor at will on the display.

Detail Description Paragraph:
[0393] The CPU interface to an RF card at the roving unit enables each golf cart to communicate information to the base station RF card located in the pro shop or other convenient location on the course. The antenna location either provides good direct line-of-sight communication to all carts on the course, or can be adapted to do so by means of repeaters, reflectors or the like as previously described herein. The mobile (roving unit) RF receiver receives data from the base transmitter and stores it in memory for use in calculating its position and for other tasks. The mobile RF transmitter transmits serial data to the base station receiver identifying the cart and its location every few seconds. By virtue of these transmissions, the specific location of each cart is determined and identified on the digital mapping display on the base station monitor.

Detail Description Paragraph:
[0405] The PROLINK transceiver must be able to send digital data to support PROLINK unique requirements, and Morse code station identification data to support FCC requirements. A solid state switch is used to pass either the digital data, or the Morse code information. The PROLINK transceiver has no provision to send traditional analog voice information. Even though only digital data or a Morse code tone is transmitted, an audio low pass filter has been implemented to prevent any possibility of over modulation of the transceiver. The low pass filter is a third order Butterworth design and completely meets the FCC requirements. Additionally, the transmit binary digital data stream edges are rounded to reduce the modulation index and hence the occupied bandwidth of the transceiver. The PROLINK digital modulation circuits physically can not have a frequency deviation of more +4 kHz by design in that the varactor tuning range is incapable of anything greater.

Detail Description Paragraph:
[0420] The outline of each object on the golf course is determined by collecting DGPS position data around the perimeter of each object. Objects that are simply linear such as golf cart paths or narrow streams are surveyed by collecting data along them from one end to the other. The output of the GPS receiver as it is moved along the object perimeter are geodetic coordinates at regular time intervals,

typically 1 per second. It is understood that universal transverse mercator (UTM) coordinates could also be used instead of geodetic coordinates. These coordinates are stored for later post-processing as will be discussed shortly. Moreover, each object is identified by a unique object number and an object type to determine how it is post-processed and drawn when displayed.

Detail Description Paragraph:
[0439] Once the outline of the golf course has been obtained and stored in the manner described above, such data can be used to generate an efficient method for determining and detecting the location of a golf cart within various zones or regions of the golf course. Such a zone detection algorithm is necessary to implement system features such as the automated hole display sequencing, whereby color monitor 19 of the golfer's cart automatically displays the current hole being played, and the speed/pace of play timing both of which require knowledge of where the golf cart is relative to important zones/regions within the golf course such as a particular tee zone or green zone.

Detail Description Paragraph:
[0440] The PROLINK system is based on a concept of "zones" which can be defined geometrically such as by a circle, an ellipse or a rectangle. The zone is created by encompassing the area of interest with one or more of the desired geometric shape. With this mathematical description of each area via the zone shapes, the coordinates of a golf cart can be compared against each zone to determine whether or not the golf cart is inside a specific zone, and hence in a specific area of interest. As an example, a rectangular zone shape is very efficient for this application. A rectangle on the golf course map can be described on an x-y coordinate grid by its center (X0, Y0), semi-major and semi-minor axis DX and DY, and rotation angle .alpha. of the semi-major axis with respect to the survey grid x axis. Given the specific coordinates of a golf cart as denoted by (x,y), as determined by the cart's GPS system and corrected by the cart's computer system, it can be determined if a golf cart is inside the rectangular zone using the following equations.

Detail Description Paragraph:
[0441] If the absolute values of dx and dy are respectively less than DX and DY, then the golf cart is inside the rectangle and hence inside the area of interest. To improve computation speed, the sine and cosine of the rotation angle .alpha. may be computed a priori and stored in memory. Moreover, the algorithm can be formulated to use scaled integer arithmetic to further improve speed.

Detail Description Paragraph:
[0442] By the use of such zone detection algorithms, the PROLINK system has the capability to determine when a golf cart enters any predetermined zone within the golf course. Accordingly, the feature of automatic hole sequencing can be accomplished whereby when the system detects that the golf cart leaves the green area of hole 1 and subsequently enters the tee box area of hole 2, the stored outline of hole 2 can be automatically displayed on the color monitor of the golf cart. Moreover, the feature of automatically displaying high resolution color advertisements as the cart travels from one hole to the next may be implemented by detecting when the golf cart has just exited an area associated with the green region of a hole and is in transition to the tee box region of the subsequent hole. Additionally, the feature of automatically determining and recording a golfer's pace of play for a hole may be accomplished by starting a timer when the golf cart enters the tee box region associated with a hole and stopping the timer when the golf cart leaves or exits the green region associated with that hole. This feature and algorithm will be discussed in more detail later.

Detail Description Paragraph:
[0459] Accordingly, since GPS velocity data is typically better than position data, the PROLINK system uses velocity data to reduce position errors. This is

accomplished through a filtering mechanism known as a complementary filter. Referring to FIG. 24, a block diagram-illustrating complementary filter 301 for blending position data with velocity data to improve position accuracy is shown. Such a filter is used in the X and Y horizontal axes; the PROLINK system does not display altitude data, so special filtering is not performed in the Z axis. In operation, measured velocity, V, which is a function of time; is integrated via integrator 302, to produce an estimate of position as denoted by P'. The difference between the measured position (P) and the estimated position (P') is calculated via subtractor 304 when P and P' are also functions of time. This difference is then fed back to adder 306 to correct the measured velocity via feedback gain element 308. A low feedback gain gradually blends position measurements to correct slow drift in the position estimate from the integrated velocity. A value of K between 1/30 and 1/50, for example, provides a good balance between position and velocity measurement errors for a low dynamic vehicle such as a golf cart.

Detail Description Paragraph:
[0461] The PROLINK system additionally includes a range display filtering mechanism for insuring that the display provides a fixed constant yardage readout when the golf cart is not moving. For a yardage measurement system, the golfer expects to see a constant yardage readout when the golf cart is not moving. However, without special processing, the yardage estimate may change slightly due to measurement noise even though the golf cart is stationary. The PROLINK system solves this problem by utilizing a unique zero velocity filtering algorithm for freezing the yardage readout when the golf cart is detected to be stationary.

Detail Description Paragraph:
[0462] To that end, the PROLINK system utilizes the fact that electrically-powered golf carts typically have a minimum speed when under power on level ground. Slightly depressing the pedal turns the electric motor on at a minimum RPM (revolutions per minute). The minimum speed is roughly 0.15 meters per second, which is above the typical velocity magnitude error for differential GPS navigation systems. The PROLINK system uses a filtering algorithm that averages a number of past velocity measurements, for example 4, such that if the output of the filter is below 0.15 meters per second, the golf cart is assumed to be stationary and the display of yardage is frozen on the screen. Therefore, when the golf cart is stationary, the user always observes a yardage readout that is constant and does not flicker between two or more different readouts.

Detail Description Paragraph:
[0464] By making use of the zone detection algorithm, the PROLINK system has the capability to determine the length of time it takes a golfer to play a hole, a selected plurality of holes, or an entire round of golf. The PROLINK system allows the capability of both the golf cart and the course management system to keep track of the play time using similar algorithms. Briefly, the course management system displays a running timer for each golf cart for the current hole and the round and play times for each hole completed. The golf cart computes the play times for each hole and transmits its times to the course management system. The course management system stores the play speed data for each golf cart so that it may be analyzed off-line.

Detail Description Paragraph:
[0465] Golf is typically played by moving from tee to green and then to the tee of the next hole. By making use of this fixed sequence of events and the previously described zoning algorithm, the play speed times for each hole can be computed. Referring back to the zoning algorithm, the PROLINK system has defined predetermined zones or regions around the tee boxes and greens (as well as other objects) of each hole to encompass the areas where players usually park their carts while teeing off and putting. The zone detection algorithm may be used to determine if the cart is near a tee or a green. The time required for the golf cart to move from the tee box of a hole to the tee box of the next subsequent hole is the play

time for that hole Time is kept for each hole by using the CPU clock which, as previously described, is calibrated with GPS time from the GPS receiver.

Detail Description Paragraph:
[0466] The algorithm in place on the golf carts operates in the following manner. When the algorithm detects that the golf cart has entered the zone of a tee box associated with the current hole being played, the play timer is started. The algorithm then waits for the golf cart to enter the green zone of such current hole and for the cart to remain in that zone for a predetermined minimum period of time, for example, 15 seconds. This time period must be long enough to prevent it from being exceeded by simply driving the cart through the green zone, but it must be shorter than the minimum time required to putt. After the cart spends the required time in the green zone, the algorithm expects the cart to enter the tee zone of the next subsequent hole. When this occurs, the play timer for the hole is stopped and a timer for the next hole is started. Additionally, the cart transmits the time of the completed hole to the course management system.

Detail Description Paragraph:
[0469] Referring to FIG. 25, a display on the color monitor 54 of CMC 41 illustrates the times for the current hole being played, the completed holes, and the cumulative time for the round for each active golf cart. The cart (car) number is shown on the left side of the display, the times for each hole played are shown to the right of the cart and target time for each hole is shown along the top. At the far right of the display, the total round time, the target time for the holes played and the time behind or ahead of the target time is shown. When hole or round times exceed the target play times, the cart symbols on the map can be highlighted or the colors for that display can be changed thereby allowing the operator to quickly identify slow playing carts.

Detail Description Paragraph:
[0472] Cost effective color display sunlight readability is one of the most difficult technical problems today. However, the PROLINK system provides an unique technique for providing high resolution color graphics with sunlight readability. To accomplish this feature, the PROLINK system is located in the roof of a golf cart. Such a roof location provides unobstructed access to the PROLINK system while at the same time making the system non-intrusive to the golfer by preserving the fill 360.degree. field of view of the golf course from the golf cart. More importantly, the roof mounted design provided shade for the color monitor so that the golfer was not viewing the display with a bright sunlight background.

Detail Description Paragraph:
[0473] Additionally, the underside of the golf cart roof is colored black and has a diffuse coating for scattering light. The color black significantly improves the effective display contrast while the diffuse coating significantly reduces the reflectivity of the roof underside.

Detail Description Paragraph:
[0474] Moreover, referring to FIG. 26, screen 47 of color monitor 19 is canted back by a predetermined angle (.alpha.), for example, 7.5.degree., by the bezel that surrounds the screen such that the screen is titled away from the golfer. This requires an angle of incidence of a light ray entering the golf cart to be near horizontal for the light ray to reflect off the display and into the golfer's eyes. The likelihood of a near horizontal light ray is very small compared to the likelihood of a light ray coming in at a different angle. Accordingly, this results in substantially reduced glare.

Detail Description Table CWU:
1 Base Packets Packet Identification Packet Function Broadcast Rate 00.sub.hex2 Differential GPS 1 Hz 01.sub.hex Text Message As Required 02.sub.hex Pin/Tee Box Placement 1 hole each 16 sec 03.sub.hex Network Control 1 time each 4 frame cycles

minimum or on channel/ size change. 04.sub.hex Roving Unit Control As Required 05.sub.hex System Data As Required

Detail Description Table CWU:
2 Roving Unit Packets Packet Identification Packet Function Broadcast Rate 00.sub.hex Roving Unit State Depends on Network Size 01.sub.hex Extended Status When required only 02.sub.hex Speed of Play When required only 03.sub.hex Distance travelled/On Time

Detail Description Table CWU:
3 Byte C Language Type Byte Identification Range 0-1 unsigned short bit synchronization BFFF.sub.hex 2 unsigned char message identification 40.sub.hex-7F.sub.hex 3-4 unsigned short number of message bytes 0000.sub.hex - FFFF.sub.hex 5 unsigned char header error detection 00.sub.hex-FF.sub.hex 6 unsigned char first packet identification 00.sub.hex-FF.sub.hex -- -- -- -- -- -- -- -- -- unsigned char second packet identification 00.sub.hex-FF.sub.hex -- etc.

Detail Description Table CWU:
4 Packet 0 - DGPS C Language Byte Type Byte Identification Range 0 unsigned packet identification 80.sub.hex or char 00.sub.hex 1 N/A start of header sub packet -- -- 6 N/A end of header sub packet 7 N/A start of first sub packet defined in header (length = i) -- -- -- -- -- -- -- -- 7 + i - 1 N/A end of first sub packet defined in header (length = i) 7 + i N/A start of second sub packet defined in header (length = i) -- -- -- -- -- -- -- -- 7 +2 * i - 1 N/A end of second sub packet defined in header (length = i) -- -- -- -- -- -- -- -- -- -- -- -- 7 + N * i N/A start of N.sup.th sub packet defined in header (length = i) -- -- -- -- -- -- -- -- 7 + (N + 1) * i N/A end of N.sup.th sub packet - 1 defined in header (length = i)

Detail Description Table CWU:
5 Byte C Language Type Byte Identification Range 0-1 unsigned short sub packet type/number of fol- 0000.sub.hex - lowing sub packets FFFF.sub.hex 2-3 unsigned short modified Z-count/station health 0000.sub.hex - FFFF.sub.hex 4 unsigned char error detection 00.sub.hex - FF.sub.hex

Detail Description Table CWU:
8 Byte C Language Type Byte Identification Range 0 unsigned char scale factor/UDRE/SV ID 00.sub.hex-FF.sub.hex 1-2 short pseudo range correction 0000.sub.hex- FFFF.sub.hex 3 short range rate correction 00.sub.hex-FF.sub.hex 4 unsigned char issue of data 00.sub.hex-FF.sub.hex 5 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
9 Bits Function 7 pseudo range/range (0: PR = 0.02 m, RR = 0.002 m/s) rate scale factor (1: PR 9.32 m, RR 0.032 m/s) 6-5 UDRE 00.sub.binary - 1.sigma. .ltoreq. 1 meter 01.sub.binary - 1 meter < 1.sigma. .ltoreq. 4 meters 10.sub.binary - 4 meters < 1.sigma. .ltoreq. 8 meters 11.sub.binary - 1.sigma. > 8 meters 4-0 SV ID range = 1 to 32, where 32 = 00000.sub.binary

Detail Description Table CWU:
10 Byte C Language Type Byte Identification Range 0 unsigned char SF/UDRE/SV ID 00.sub.hex-FF.sub.hex 1-2 unsigned char delta pseudo range correction 0000.sub.hex-FFFF.sub.hex 3 short delta range rate correction 00.sub.hex-FF.sub.hex 4 char issue of data 00.sub.hex-FF.sub.hex 5 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
11 Byte C Language Type Byte Identification Range 0-2 N/A constellation health 000000.sub.hex- FFFFFF.sub.hex 3 unsigned char error detection 00.sub.hex-FF.sub.hex

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Detail Description Table CWU:
12 Bits Function 23-19 Satellite ID: SV ID range = 1 to 32 and where 32 = 00000.sub.binary 18 Issue of data link: 0 indicates this information refers to nav data with LOD in ty 1 or type 9 message. 1 indicates this information refers to nav data with IOD in type 2 message 17-15 Data health: see table 20-VII of ICD-GPS-200 14-9 Carrier to noise ratio: sf = 1dB/Hz, range = 25 to 56, LBS is bit 13 8 Health enable: if 1, SV is healthy even though SV nav data indicates unhealthy 7 New navigation data: new SV nav data is being collected that will soon result in new IOD for the type 1 message 6 Navigation data warning: a 1 indicates a problem in SV nav data 5 Loss of satellite warning: if i then SV is-scheduled to be switched to unhealthy 4-2 Time to unhealthy: if but 17 is set, then bits 18-21 define how much time until SV is set unhealthy. LSB = 5 minutes. Range is 0 to 80 minutes 1-0 spares

Detail Description Table CWU:
13 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 01.sub.hex 1 unsigned char cart address 00.sub.hex-FF.sub.hex 2 unsigned char issue of data message 00.sub.hex-FF.sub.hex 3 unsigned char number of frames for message/ 00.sub.hex-FF.sub.hex current frame number 4 unsigned char ASCII character 1 00.sub.hex-FF.sub.hex 5 unsigned char ASCII character 2 00.sub.hex-FF.sub.hex 6 unsigned char ASCII character 3 00.sub.hex-FF.sub.hex -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 27 unsigned char ASCII character 24 00.sub.hex-FF.sub.hex 28 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
14 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 02.sub.hex 1 unsigned char hole number 00.sub.hex-FF.sub.hex 2-3 short pin X position (LSB = 8000.sub.hex-7FFFF.sub.hex 2.sup.-3) (2.sup.+5 complement for) -4096 m-4095.875 m 4-5 short pin Y position (LSB = 8000.sub.hex-7FFFF.sub.hex 2.sup.-3) (2.sup.+5 complement for) -4096 m-4095.875 m 6 unsigned char front tee/front-middle 00.sub.hex-FF.sub.hex tee 7 unsigned char back-middle tee/back 00.sub.hex-FF.sub.hex tee 8-9 unsigned short packet checksum 0000.sub.hex-FFFF.sub.hex

Detail Description Table CWU:
15 Byte C Language Type Byte Identification Range 0 unsigned char packet identification 03.sub.hex-83.sub.hex 1-2 unsigned short GPS week since Jan 6, 0000.sub.hex- 1980 FFFF.sub.hex 3-4 unsigned short seconds in the week since 0-604,800 s midnight Saturday (LSB = 10 seconds) 5 unsigned char frequency / network status 00.sub.hex-FF.sub.hex 6 unsigned char current number of frames / 00.sub.hex-FF.sub.hex new number of frames 7 unsigned char network frame counter 00.sub.hex-FF.sub.hex 8 unsigned char network duty cycle control 00hex-FF.sub.hex 9 unsigned char spare 00.sub.hex 10, 11, 12 unsigned char error detection 000000.sub.hex-FFFFFF.sub.hex

Detail Description Table CWU:
16 Bits Function 0-3 bits 0-3 = 0.sub.hex -- > network continues operating in its previous state bits 0-3 = 1.sub.hex -- > halt network (rogues immediately cease transmitting) bits 0-3 = 2.sub.hex -- > restart network (rogues immediately begin transmitting in their time slots defined by bytes 16 and 17 conditioned by byte 18 - duty cycle) bits 0-3 = 3.sub.hex -- > station identification to follow bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = 4.sub.hex -- > Spare bits 0-3 = F.sub.hex -- > Spare 4-7 bits 4-7 = 0.sub.hex -- > tune to channel 0 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = 1.sub.hex -- > tune to channel 1 bits 4-7 = F.sub.hex -- > tune to channel 15

Detail Description Table CWU:
18 Byte C Language Type Byte Identification Range 0 unsigned char packet

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identification 04.sub.hex or 84.sub.hex 1 unsigned char cart address 01.sub.hex-FF.sub.hex 2 unsigned char re transmit control / current 00.sub.hex-FF.sub.hex frame 3 unsigned char transmit frame number / total 00.sub.hex-FF.sub.hex number of frames 4 subframe/spare 0-F 5 spare 0 6-7 unsigned short error detection packet check 0000.sub.hex- sum FFFF.sub.hex

Detail Description Table CWU:
20 Byte C Language Type Byte Identification Range 0 unsigned char packet id 0.times.05 1 signed char time zone offset 2's complement .+-. 50 (LSB = 900 seconds) (.+-. 14 hours) 2-7 -- spares 0 8-9 unsigned short error detection 0000-FFFF

Detail Description Table CWU:
21 Byte C Language Type Byte Identification Range 0-1 unsigned short bit synchronization BFFF.sub.hex 2-3 unsigned short message / packet identi-00.sub.hex-3F.sub.hex fication 4 -- packet contents -- -- -- -- -- -- -- -- -- -- 8 -- end of packet --

Detail Description Table CWU:
22 Bits Function 15 1 - terminate bit synchronization properly 14-7 Message identification byte (same as rogue ID or address) 00.sub.hex - no definition 01.sub.hex - cart 1 02.sub.hex - cart 2 03.sub.hex - cart 3 03.sub.hex - cart 3 03.sub.hex - cart 3 03.sub.hex - cart 3 FF.sub.hex - cart 255 6-4 00.sub.hex - packet 0 01.sub.hex - packet 1 02.sub.hex - packet 2 02.sub.hex - packet 2 07.sub.hex - packet 7 3-0 error detection

Detail Description Table CWU:
23 Byte C Language Type Byte Identification Range 0 unsigned char rogue status 00.sub.hex-FF.sub.hex 1-3 N/A rogue position 000000.sub.hex- FFFFFF.sub.hex 4 unsigned char packet error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
26 Byte C Language Type Byte Identification Range 0 unsigned char cart status 1 00.sub.hex-FF.sub.hex 1 unsigned char cart status 2 00.sub.hex-FF.sub.hex 2 unsigned char cart status 3 00.sub.hex-FF.sub.hex 3 unsigned char cart status 4 00.sub.hex-FF.sub.hex 4 unsigned char error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
27 Byte C Language Type Byte Identification Range 0 unsigned character rogue status 00.sub.hex-FF.sub.hex 1 unsigned character rogue statues byte with hole C1.sub.hex-F6.sub.hex code set 2 unsigned character score: player 1 in low nibble, 00.sub.hex-FF.sub.hex player 2 in high nibble; Score range is 1-15 0 = no score data 3 unsigned character hole play time - LSB 10 sec 00.sub.hex-FF.sub.hex 4 unsigned character error detection 00.sub.hex-FF.sub.hex

Detail Description Table CWU:
28 Byte C Language Type Byte Identification Range 0 unsigned char rouge status 00-FF 1-2 unsigned char distance traveled (LSB = 1 0000-FFFF meter) 3 unsigned char PROLINK on-time (LSB = 300 00-FF sec) 4 unsigned char error detection 00-FF

Hit List

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Search Results - Record(s) 1 through 11 of 11 returned.

☐ 1. Document ID: US 20020016674 A1

Using default format because multiple data bases are involved.

L5: Entry 1 of 11 File: PGPB Feb 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020016674
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020016674 A1

TITLE: Golf course yardage and information system having improved zone information and display characteristics

PUBLICATION-DATE: February 7, 2002

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US-CL-CURRENT: 701/215; 473/407

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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PGPUB-DOCUMENT-NUMBER: 20020011949
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DOCUMENT-IDENTIFIER: US 20020011949 A1

TITLE: Golf course yardage and information system with zone detection

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

☐ 3. Document ID: US 20020010544 A1

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L5: Entry 3 of 11 File: PGPB Jan 24, 2002

PGPUB-DOCUMENT-NUMBER: 20020010544
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020010544 A1

TITLE: Display monitor for golf cart yardage and information system

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 4. Document ID: US 6525690 B2

L5: Entry 4 of 11 File: USPT Feb 25, 2003

US-PAT-NO: 6525690
DOCUMENT-IDENTIFIER: US 6525690 B2

TITLE: Golf course yardage and information system with zone detection

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 5. Document ID: US 6470242 B1

L5: Entry 5 of 11 File: USPT Oct 22, 2002

US-PAT-NO: 6470242
DOCUMENT-IDENTIFIER: US 6470242 B1

TITLE: Display monitor for golf cart yardage and information system

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 6. Document ID: US 6236940 B1

L5: Entry 6 of 11 File: USPT May 22, 2001

US-PAT-NO: 6236940
DOCUMENT-IDENTIFIER: US 6236940 B1

TITLE: Display monitor for golf cart yardage and information system

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 7. Document ID: US 6236360 B1

L5: Entry 7 of 11 File: USPT May 22, 2001

US-PAT-NO: 6236360
DOCUMENT-IDENTIFIER: US 6236360 B1

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TITLE: Golf course yardage and information system

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 8. Document ID: US 5878369 A

L5: Entry 8 of 11 File: USPT Mar 2, 1999

US-PAT-NO: 5878369
DOCUMENT-IDENTIFIER: US 5878369 A

First Hit Fwd Refs
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☐ Generate Collection | Print

L5: Entry 11 of 11 File: USPT Mar 11, 1997

DOCUMENT-IDENTIFIER: US 5610586 A
TITLE: Golf cart control and monitoring apparatus and system

Abstract Text (1):
A golf cart control and monitoring apparatus, includes a signal transmitter, at least one antenna, a signal receiving and processing device, and an event log device. The signal transmitter transmits a plurality of electromagnetic signals, each signal being representative of a position with respect to a restricted area of a golf course. The signal receiving and processing device receives the electromagnetic signals radiating from the antenna and provides output signals representative of the location of the cart with respect to the restricted area, where at least one of these output signals is representative of the golf cart being located in the restricted area. The event log device is responsive to the signal receiving and processing device and generates historical log of how long and how many times the golf cart was located within golf course restricted areas. In another embodiment, a plurality of ranging signals are transmitted from a number of antennas located at known location on the golf course and the signals receiving and processing device includes a microprocessor for determining the location of the cart with respect to the restricted area based on these ranging signals.

Brief Summary Text (2):
This invention relates to a control and monitoring apparatus for golf carts and more particularly to an apparatus which monitors the movement of a golf cart with respect to golf course restricted or protected areas, which provides an event history of golf cart movement with respect to at least a portion of such areas, and which provides visual and/or auditory alerts and alarms so a golf cart operator can avoid such areas.

Brief Summary Text (4):
Maintenance of golf courses involves a significant amount of time and expense. This time and cost for maintenance is impacted when golf carts are driven onto areas of the golf course (e.g. the greens) where the traveling golf carts can cause damage. In addition to the cost and time associated with fixing the damaged grounds, the damage areas can inconvenience golfers, affect play, and in general make a golfer's use of the course less enjoyable.

Brief Summary Text (5):
There are two methods available for controlling the movement of golf carts while they are being operated on golf courses. One method involves providing some sort of warning to identify restricted areas of the golf course so the golf cart operator can avoid them. In the second method a predetermined course of action is dictated to the cart operator in the event the operator does not heed the warnings identifying restricted areas.

Brief Summary Text (7):
The alternate scheme, disclosed in U.S. Pat. No. 4,656,476, uses an antenna/transmitter combination to identify the boundaries of the restricted areas; uses a receiver and signal processor to receive the transmitted signals and

generate an output signal when the signal strength has exceeded a threshold; and provides visual/auditory alarms, responsive to the output signals, for the operators to determine where to drive the golf carts. Three visual alarms are used to indicate that the golf cart is approaching the outer boundary of a restricted area, to indicate that the cart is approaching a restricted area, and to indicate that the cart has entered a restricted area. An auditory alarm can be used to supplement the visual warnings.

Brief Summary Text (10):
The golf cart control system, disclosed in U.S. Pat. No. 5,053,768, provides both alarms to induce operator action and means for enforcing a predetermined course of action if the golf cart is not removed from a restricted area within a predetermined period of time. This system identifies the boundary of the restricted area by means of an single antenna and transmitter. When a signal above a predetermined threshold is received, the cart control system receiver package located on the golf cart, provides a visual warning (e.g., a single colored light) that the cart is entering a restricted area. This signal also starts a timer used to generate a second visual alarm if the golf cart has not exited the restricted area within a preset time.

Brief Summary Text (11):
If the operator fails to exit the restricted area within the preset time, the system has provisions for disabling the golf cart so it cannot be driven further in the forward direction in the protected area. Rather the golf cart is disabled so that it can only be driven in reverse or "backed out" of a restricted area. Disablement is accomplished by interconnecting the golf cart's drive with the cart control system. Disabling of the cart along with prespecifying the cart's direction of travel has certain short comings.

Brief Summary Text (14):
If an operator is not familiar with the disabling function or does not believe a restricted area had been entered, the operator may incorrectly conclude that the cart has had a power or transmission failure. The delay in resolving the reason for the golf cart's failure can impact or delay the play of other golfers, as well as annoy the operator. The operator could also become annoyed because the cart has become disabled and the operator is being forced to back-up the golf cart. Since golf like many games is part mental attitude, a golfer is quite likely to blame a bad hole or bad game on the problems with the cart. While protecting restricted areas is important, annoying golfers or interfering with the game of other golfers is not necessarily in the best interests of the golf course.

Brief Summary Text (15):
As a practical matter, the predetermined time period is on the order of about 2 seconds to assure that a golf cart does not make a large incursion into a restricted area (i.e., a golf cart traveling at 10 mph will traverse about 30 feet or 10 yards in 2 seconds). Because of the restrictive turn radius of golf carts, it is quite likely that the predetermined time period will expire before the cart can be turned around to exit the area. Thus, operators who turn their cart around and are exiting in compliance with the first warning will be forced to back-up out of the restricted area. This would happen even if driving forward would be the fastest and best way to exit. The likelihood of the time expiring before exiting becomes greater for operators who are moving at speeds slower than that assumed for determining the preset time period.

Brief Summary Text (16):
Disabling the cart also involves interfacing and interconnecting the cart control system with the controls and drive system for the golf cart. This increases the complexity of the cart control system and creates another failure mode for the cart. Since it is a common practice for golf courses to rent their golf carts, it is quite possible that such modifications to disable a cart would not be allowed by

the cart owner; could only be done by the cart owner at the golf course's expense; or could involve additional charges from the owner to return the cart back to its as rented condition (e.g., repair cart). These added costs will likely exceed the typical rental charges, especially for daily rentals. Alternatively the golf course would have to purchase carts in lieu of renting them.

Brief Summary Text (17):
Rental carts are a concern because they are usually obtained when a golf course is anticipating a large number of guests for special events such as tournaments. Damage to restricted areas is more likely to occur at these times because the guests are not familiar with course rules and the areas of the course to be avoided. As such, rental cart usage and the potential for damage must be addressed.

Brief Summary Text (18):
Other systems involving golf cart control or locating a golf cart with respect to some feature of the golf course are disclosed in U.S. Pat. Nos. 4,480,310 and 4,926,161.

Brief Summary Text (21):
Therefore, it is an object of the present invention to provide a golf cart control and monitoring apparatus that monitors golf cart usage so cart operators who intrude into restricted/protected areas of a golf course can be identified and so these operators can be held accountable for their actions after and/or during a game.

Brief Summary Text (22):
It is a further object of the present invention to provide an apparatus that does not involve controlling the operation of a golf cart to prevent intrusion or further intrusion into a restricted area (e.g., disabling the cart).

Brief Summary Text (24):
It is yet a further object of the present invention to provide an apparatus that provides both visual and auditory alarms/signals to a golf cart operator to identify restricted areas so the operator will not intrude into these areas.

Brief Summary Text (26):
It is still yet another object of the present invention to provide an system which uses RF signal triangulation techniques for determining the location of the golf cart with respect to protected areas.

Brief Summary Text (29):
This invention features a golf cart control and monitoring apparatus/system that monitors golf cart usage with respect to golf course restricted areas. The apparatus provides visual and auditory alarms to cart operators advising them of restricted areas so that the operators can avoid these areas. The apparatus also includes provisions so that cart operators who intrude into restricted/protected areas of a golf course can be identified and so these operators can be held accountable for their actions after and/or during a game. The instant invention can be practiced using three different antenna configurations; at least one antenna disposed about the boundary of a restricted area and preferably below grade, at least two antennas disposed about the boundary of a restricted area and preferably below grade, and a plurality of above ground antennas spaced from each other and being disposed about and beyond the restricted area boundary that radiate ranging signals and more particularly define a set of ranging signals.

Brief Summary Text (30):
The golf cart control and monitoring apparatus of one embodiment of the instant invention includes a signal transmission means having at least one antenna, a signal receiving and processing means, and an event log means. The signal

transmission means transmits a plurality of electromagnetic signals, each signal being representative of a position with respect to a restricted area of a golf course. Preferably, the signal transmission means includes an antenna disposed about the restricted area of the golf course and being below grade.

Brief Summary Text (31):
The signal receiving and processing means receives and process the electromagnetic signals radiating from the at least one antenna and provides output signals representative of the location of the cart with respect to the restricted area. At least one of these output signals is representative of the golf cart being located in the restricted area.

Brief Summary Text (32):
The event log device is responsive to the signal receiving and processing device and generates a log of how long and/or how, many times the golf cart was located within golf course restricted areas. In alternate embodiments, the event log means includes an event counter that counts each time the cart is considered to have entered into the restricted area and a time accumulation means for determining the amount of time the cart is considered to be in the restricted area, as well as means for displaying the number of restricted area entries and the amount of time the cart was in restricted areas.

Brief Summary Text (33):
Preferably the signal receiving and processing means includes determining means for determining when the golf cart is approaching the restricted area (i.e., cart in a warning area) and when the cart is considered located in a restricted area. The signal receiving and processing means outputs a first output signal when the cart is determined to be in the warning area and a second output signal when the cart is considered to be located in the restricted area. More particularly, the signal transmission means generates a plurality of repetitive signal pulses and the signal receiving and processing means includes means for determining based on these signals pulses when the cart is in the warning area and when the cart is considered located in the restricted area.

Brief Summary Text (36):
In another embodiment of the instant invention, a system for controlling and monitoring includes a device for controlling and monitoring the operation of the golf cart and a set of at least three remote transmitters. The set of at least three remote transmitters are located at known locations about the golf course to define a triangle encompassing a substantial portion of the golf course, including golf course restricted areas. Each of the transmitters transmits a repetitive ranging signal and the combined ranging signals from the set of transmitters defines sets of ranging signals.

Brief Summary Text (37):
The controlling and monitoring device is disposed on the golf cart and includes a receiving means, a signal processing and control means and an event log means. The receiving means receives the sets of ranging signals and the signal processing and control means processes each set of ranging signals to determine the location of the golf cart with respect to a predetermined feature of the golf course. The processing and control means provides or outputs control signals, each control signal being representative of the cart's location with respect to a predetermined feature, where at least one of the control signals outputted is representative of the cart being located in a restricted area.

Detailed Description Text (3):
In FIG. 1A, two antennas 20a,b are disposed about the boundary of the restricted area 22 and are preferably disposed below grade so that they do not interfere with golf play or maintenance activities such as the cutting of grass. In this way, a golf cart 24 cannot approach the restricted area 22 without the signal receiving,

processing and display means 26, located on the golf cart 24, from first receiving an electromagnetic signal radiating from the outer antenna 20a. Similarly, the golf cart cannot enter into the restricted area, which is bounded by the inner antenna 20b, without next receiving an electromagnetic signal from the inner antenna.

Detailed Description Text (4):
As shown in FIG. 1B, the outer and inner antennas 20a,b are spaced from each other to establish two alert zones 28a,b. The first alert zone 28a extends outward from the second alert zone 28b and covers the area about the restricted area 22 where a cart operator is to be given a warning that the cart is approaching a restricted area. The second alert zone 28b covers both the restricted area 22 and the area between the inner antenna 20b and the inner boundary of the first alert zone 28a. The second alert zone 28b is the zone in which a cart operator is to receive a warning that the cart is in a restricted area and in which information, wanted by the golf course representatives concerning intrusions into the second alert zone (i.e., the restricted area) by a golf cart, is begun to be accumulated. In sum, the two alert zones 28a,b provide a basis for establishing different visual and auditory queues for the cart operator, as well as establishing the different monitoring criteria for the golf carts.

Detailed Description Text (6):
In another embodiment, as shown in FIG. 1C, a single antenna 120 is disposed about the boundary of the restricted area 122 and is preferably disposed below grade so that it does not interfere with golf play or maintenance activities such as the cutting of grass. In this way, a golf cart 124 cannot approach the restricted area 122 without the signal receiving, processing and display means 126 receiving an electromagnetic signal radiating from the antenna 120. As explained hereinafter concerning FIG. 2A, if the golf cart continues to travel in or about the restricted area a second signal is generated indicating that the cart is located in a restricted area. As with the dual antenna configuration of FIG. 1A, B, this in effect establishes two areas, a warning area about the restricted area and the restricted area.

Detailed Description Text (9):
The interface boundary 129 between the first and second alert zones 128a,b is set so a cart operator has sufficient time and distance to change the golf cart's direction after entering the first alert zone 128a such that the cart does not intrude into the second alert zone 128b and correspondingly the restricted area 122. The setting of the interface boundary 129 takes into consideration the estimated speed of the cart, the amount of time typically taken for a cart to change direction, and the minimum distance available for a golf cart 124 to travel before it would enter the restricted area after a signal from the antenna 120 is first received. After a cart has entered or is considered to have entered the second alert zone 128b, as explained in connection with FIG. 3A, the cart will be considered to be in this zone until it departs from at least the area bounded by the antenna 120 or until it departs the first alert zone 128a (i.e., signals from antenna 120 no longer being received).

Detailed Description Text (18):
As discussed above in connection with FIGS. 1C-E, the antenna 120 is located about a restricted area 122 of the golf course so a golf cart cannot enter the restricted area without first passing through the electromagnetic field radiating from the antenna 120. The lines 119, interconnecting the lightning module 121 to the antenna 120, are typically twisted so an electromagnetic signal is not radiated therefrom and so a false signal is not provided to the signal receiving, processing and display means 126 (see FIG. 3A).

Detailed Description Text (22):
Preferably the transmitter 118 (FIG. 2A) has a power output such that electromagnetic signals being radiated from the antenna 120 cover the area defined

by the first and second alert zones 128a,b. As such, when a golf cart 124 is in either the first alert or second alert zone 128a,b (see FIG. 1D), the receiver 140 receives the electromagnetic signals being radiated from the antenna 120 (see FIG. 1D,E) and the receiver provides a pulsed output signal 141 representative thereof.

Detailed Description Text (23):
The receiver pulsed output signal 141 is provided to the signal processing means 142. In response to the pulsed output signal 141, the signal processing means 142 outputs signals to the display means 144 so the appropriate visual alarms/messages 164, 182 and auditory alarms 156 are actuated to indicate that the golf cart is in either the first or second alert zone 128a,b. The following describes how the signal processing means 142 and display means 144 accomplishes this.

Detailed Description Text (27):
As discussed above, the interface boundary 129 between the first and second alert zones 128a,b is set so a cart operator has sufficient time and travel distance to turn the golf cart around after entering the first alert zone 128a so that the cart does not intrude into the second alert zone 128b. If the cart 124 continues to travel in or about the first alert zone 128a or travels further and enters into the second alert zone 128b, a second signal is generated to indicate that the cart is located in the second alert zone 128b or the restricted area 122. That is, if the cart has not exited the first alert zone 128a prior to the generation of the second signal, then the cart is presumed or considered to be in the second alert zone 128b for monitoring and alarm purposes.

Detailed Description Text (28):
For the single loop antenna 120 of FIGS. 1C-E, a pulse counter 171 is preferably used to accomplish the second signal generation function. It is within the scope of the present invention to use other means well known in the art for generating a signal after satisfying a precondition requirement. For example, a timer circuit/component may be provided that starts when signal pulses are received indicating that the cart is located in the first alert zone 128a. In this case, when a preset amount of time has elapsed the timer circuit/component provides an output signal to trigger the functions associated with the second alert zone (e.g., incrementing of the event counter 176). Alternatively, means could be provided for determining the distance traveled by the golf cart to determine if it exceeds a preset number (e.g., equating the number of cart wheel revolutions to a travel distance).

Detailed Description Text (32):
The second output of the flip-flop 172 provides a continuous signal to the first OR gate 150 so another auditory signal is sounded by the auditory alarm 156 indicating that the golf cart has entered the second alert zone 128b. The auditory signal produced by the auditory alarm 156, when it receives a signal from the second flip-flop output 177, is continuous and distinctive from the auditory signal generated when the cart is in the first alert zone 128a. It should be recognized that the auditory alarms generated for the first and second alert zones 128a,b respectively are not limited to that described above. The auditory alarms may be of any style and duration as long as the auditory signals generated for the two alert zones 128a,b are preferably distinguishable from one another.

Detailed Description Text (45):
For the antenna/receiver configurations of FIGS. 1A-E, the position of the golf cart is determined based on the physical arrangement of the antennas about each restricted area 22,122 of the golf course (e.g., antennas bound, encircle or encompass area to be protected) and the extent of signal coverage from these antennas. There is shown in FIGS. 1F,G yet another embodiment of the present invention where the position of the golf cart with respect to a restricted area does not require arranging an antenna(s) about each restricted or protected area to define the boundary of each restricted area and the different alert zones. Rather

for this embodiment, the position of the golf cart is determined based on the signals radiating from a plurality of remotely located antennas 220a-c.

Detailed Description Text (46):
In FIG. 1F, a plurality of antennas 220a-c and associated signal transmission means 216a-c are disposed about and generally beyond (i.e., external to) the boundary of the restricted area 222. The antennas 220a-c are spaced from each other and located so that they do not interfere with golf play or maintenance activities such as the cutting of grass. As provided in the discussion for FIG. 3B, the golf cart's signal receiving, processing and display means 226 uses the signals being radiated by these antennas to determine the location of the cart 224 on the golf course in the area covered by the antenna signals and with respect to the restricted areas 222. Then, using this information the signal receiving, processing and display means 226 responds in one fashion when the golf cart 224 is approaching the restricted area 222 (i.e., located in a warning area, the first alert zone 228a) and responds in another fashion when the golf cart 224 is located in the restricted area 222 (i.e. the second alert zone 228b).

Detailed Description Text (48):
Given the known locations of the antennas 220a-c, the signals radiating from the antennas are used to determine the position of the golf cart 224 with respect to any of a number of restricted areas (i.e., antennas cover more than one restricted area). The number of antennas and signal transmission means being used is established giving due consideration to the power output of each transmitter, the geographical and topographical layout of the golf course, the location and type of protected areas, the sensitivity of the receiver and the complexity of the electronics making the positional calculations/determinations.

Detailed Description Text (49):
As shown in FIG. 1G, two alert zones, a first and a second alert zone 228a,b are defined for each protected area 222. As with FIG. 1B,1D, the first alert zone 228a extends outward from the second alert zone 228b and covers the area about the restricted area 222 where a cart operator is given a warning that the cart 224 is approaching a restricted area. Similar to FIGS. 1B,1D, the interface boundary 229 between the first and second alert zones 228a,b is set so that a cart operator has sufficient time to change the golf cart's direction after entering first alert zone 228a.

Detailed Description Text (51):
The transmitter means 216a-c each transmit repetitive RF ranging signals from the corresponding antennas 220a-c. The ranging signal pulses from the antennas 220a-c are sequentially staggered in a predetermined order to define a set of sequentially spaced, in time, ranging signal pulses. There is also a time gap between each set of ranging signal pulses that is substantially greater than the time gap between the successively transmitted ranging signal pulses of a set. In this way, the first ranging signal pulse of each set is readily identifiable and there is also defined a plurality of repetitively transmitted ranging signal pulses. As provided in the discussion for FIG. 3B, the sets of ranging signals are used to determine the position of the golf cart on the golf course and more particularly, the position of the cart with respect to areas to be protected about the golf course.

Detailed Description Text (53):
While single frequency operation is preferred, it is within the scope of the present invention to transmit ranging signal pulses at different RF frequencies. It also should be recognized that there a number of techniques known in the art whereby a position can be determined by receiving a plurality of signals from known receiver locations. For example, the bearing of each signal from fixed radio transmitters at known locations may be used to determine the position of the golf cart. As such, it is within the skill of those in the art to modify the within apparatus to use one of these other position determining techniques.

Detailed Description Text (59):
There is shown in FIG. 3B a signal receiving, processing and display means 226 that receives the ranging signal pulses from the antennas 220a-c and determines the position of the golf cart 224 based on these signal pulses. Preferably, the signal receiving, processing and display means 226 includes position determining and control signal output means 251 that determines the location of the cart on the golf course and specifically if the golf cart is located in the first or second alert zone 228a,b defined for each protected area 222. The position determining and control signal output means 251 outputs control signals to the display means 244 when the cart is determined to be located in the first or second alert zone 228a,b and also outputs control signals to the event counters 176 and event clock 184 when the cart is located in the second alert zone 228b. The position determining and control signal output means 251 receives output signals from the receiver 240 that are representative of the ranging signal pulses emitted by the antennas 220a-c.

Detailed Description Text (61):
The processing unit 253 is a central processing unit such as a 8051 microprocessor as well as other processing units (e.g., 8 bit, 16 bit, 32 bit microprocessors) known in the art that can be used to perform the below described positional determination and signal output functions. The processing unit 253 cooperates with the information/data storage memory 255, the pulse counter 259 and the clock 257 to process the ranging signal pulses from the antennas 220a-c to determine the location of the golf cart as it travels about the golf course. The ranging signal pulses are received by the receiver 240, that outputs signals representative thereof to the pulse counter 259.

Detailed Description Text (63):
The processing unit 253 processes the first and second count signals from the pulse counter 259 in combination with the remote station transmitter-location data stored in the information/data storage memory 255 to determine the coordinates of the location of the golf cart 224 on the golf course. This is done using typical prior art range determination processing techniques based upon measuring the relative time of arrival of at least three ranging signals.

Detailed Description Text (65):
The processing unit 253 accesses the information/data storage memory 255 to compare the location or coordinates determined for the golf cart 224 with the known coordinates of predetermined features of the golf course, in particular the known coordinates of the protected areas 222 to determine the golf cart's location with respect to a predetermined feature. In the case of protected areas, a determination is made to see if the cart is located in one of the protected areas. More particularly, the processing means compares the protected area locational information with the cart's location to determine if the golf cart is located within the first or second alert zone 228a,b of any protected area 222. It is within the skill of those knowledgeable in the art, to also provide information/data in the memory 255 to indicate what hole the golf cart is located near (i.e. what hole is being played by the golfer) to simplify the processing unit's 253 look up and comparison process. In this way, the processing unit 253 may retrieve information/data from the memory 255 for the predetermined features such as the restricted areas that are within a prespecified locus about the location of the golf cart.

Detailed Description Text (68):
As indicated above, when the processing unit 253 determines that the golf cart is located in or about a protected area 222, it outputs control signals to the display means 244 and/or the event counter 176 and event clock 184. If the cart is determined to be located in the first alert zone 228a, the processing unit 253 outputs control signals to activate the first visual alarm/message 164 and the audio alarm 156 to generate a first audio output signal. When the cart exits the

first alert zone (i.e., exits the protected area), the visual alarm/message and audio alarm is terminated.

Detailed Description Text (71):
In an alternate embodiment, the signal receiving, processing and display means 226 includes a second memory storage means 261 that stores at least the identification of each protected area (i.e., second alert zone 228b) intruded into by a golf cart 224 and the position determining and control signal output means 251 provides an output signal to the second memory storage means 261 to identify the protected area being intruded. As indicated above, the position determining and control signal output means 251 in determining if a cart 224 is located in a protected area 222, also necessarily knows which area is being intruded. Alternatively, the second memory storage means 261 receives input signals from the event time clock 184 so the amount of time the cart 224 is located in a particular protected area is also known.

Detailed Description Text (72):
The data or information stored in the second memory storage means 261 is accessed by course representatives, preferably when the golf cart 224 is returned back to the club house or other designated location by the operator (e.g., golfer is through for the day). Preferably, the second memory storage means 261 drives an information display 287 so the information being accessed can be viewed by the course representative(s). This information can be used to determine what action, if any, should be taken to hold the cart operator accountable for their actions during operation of the cart as well as allowing the course representatives to go out and view the protected area(s) intruded upon to determine if there was any damage to the course grounds.

Detailed Description Text (76):
There is shown in FIG. 4 an elevation view of one embodiment of the information display 300 provided by the signal receiving, processing and display means 126,226 located on a golf cart 124,224 (FIGS. 1C,F). The informational display 300 includes a message display 302 that contains at least one pre-scripted message such as "YOU ARE ENTERING A RESTRICTED AREA-PLEASE DEPART" for display. Preferably, the message display is uniquely illuminated (e.g., by different colored lights) depending upon the location of the cart with respect to the first and second alert zones 128a,b; 228a,b. For example, when the cart is located in the first alert zone 128a,228a the message display 302 is illuminated by a yellow light and when in the second alert zone 128b,228b the message display 302 is illuminated with a red light.

Detailed Description Text (78):
The information display 300 contains a two digit event counter display 178 (see FIGS. 3A,B) that indicates the number of times a golf cart has entered into restricted areas (i.e., second alert zone) during a game. The information display 300 also contains a three digit time display 188 (see FIGS. 3A,B) that indicates the total amount of time a cart has been located in restricted areas during a game. In the illustrated example, a cart has entered restricted areas three times and has been in these areas for a total of 8.5 minutes. While two and three digit display are illustrated, this is not a limitation as the displays may have more or less digits as the actual needs may require.

Detailed Description Text (85):
As shown, before a golf cart 24 enters the cart path 25, the golf cart 24 traverses a designated start area 23a that is near the first hole. The designated start area 23a is an area designated by course management as representing when a game of golf is considered to have begun and it also represents the starting point for first hole play. Correspondingly, before a golf cart 24 exits the cart path 25 it traverses a designated stop area 23b, that is near the ninth hole. The stop area 23b is representative of when a game of golf is considered to have ended for the first nine holes and it also represents the end point for ninth hole play. While

two areas, a start and stop area 23a-b, are illustrated, the number of areas designated on a course as being representative of the starts/ends of play, as well as their respective locations on the course, are determined based on such factors as the number of holes on the course, how the game is played at a particular course, and the signal transmission means/antenna configuration being used to positionally locate the golfer/golf cart.

Detailed Description Text (89):
In an alternate embodiment to below grade antennas 21a, a plurality of above ground antennas 120a-c, and the associated transmitting means 216a-c, are provided to transmit a set of ranging signals (see discussion regarding FIGS. 1F,G; 2B and 3B), from which the signal receiving processing and display means 26 determines the location of the golf cart 24 on the golf course. More particularly a determination is made concerning whether the golf cart 24 is located in at least an area where golf is considered to be played or in one of the designated start or end areas 3a-b. Since in this type of system, the specific location of the golfer/golf cart 24 on the golf course is determined using the ranging signals, the start area may be defined as being all locations on the course where golf is played and the end area may be defined as being all locations on the course where golf is not played. Similarly, the signal receiving, processing and display means 26, based on the ranging signals, determines whether the cart is located at one of the designated intermediate travel position 23c.

Detailed Description Text (90):
As discussed below, a signal receiving, processing and display means 26 is disposed on the golf cart 24 to receive the electromagnetic signals radiating from the antennas 21a-c defining start and stop areas 23a-b and the intermediate travel positions 23c or the ranging signals from the above ground antennas 220a-c. In this way, a golf cart 14 cannot enter one of these designated areas without the signal receiving, processing and display means 26, located on the golf cart 24, from either first receiving an electromagnetic signals radiating from one of the antennas 21a-c that define these areas 23a-c or first receiving the ranging signals from which the cart's location with respect to these areas is determined.

Detailed Description Text (91):
As discussed below, concerning FIGS. 3C-D, the circuitry of the playtime monitoring and tracking means 350a-b, is preferably included along with the signal receiving and processing means 126,226 of the present invention (see FIGS. 3A,B) so all is mounted on the golf cart 24. Alternatively, because golf carts are not always used for play, an electronic package containing the playtime monitoring and tracking means 350a-b is provided to each golfer to sense and process the electromagnetic signals representative of the start and end areas 23a-b and the intermediate travel positions 23c of the golf course.

Detailed Description Text (94):
When the playtime monitoring and tracking means 350a, or the golf cart on which it is mounted, enters a start area 23a, the transmission means signal pulses are received by the first playtime receiver 145a. This receiver outputs signal pulses in response thereto to a first playtime missing pulse detector 147a. The first playtime missing pulse detector 147a, responsive to the receipt signal pulses from the first receiver 145a outputs a signal to the elapsed timer 155 that starts the elapsed timer. Since the elapsed timer 155 is reset or initialized before beginning the monitoring and tracking function (e.g., by a course representative), the elapsed timer 155 determines the amount of time that has elapsed since the entering a start area 23a. Thus, the time reflected by the elapsed timer 155 is representative of the time of play.

Detailed Description Text (95):
When the playtime monitoring and tracking means 350a, enters an end area 23b, the transmission means signal pulses are received by the second playtime receiver 145b.

The second playtime receiver 145b outputs signal pulses in response thereto to a second playtime missing pulse detector 147b. The second playtime missing pulse detector 147b, responsive to the receipt of the second receiver signal pulses, outputs a signal to the elapsed timer 155 stopping the elapsed timer. When the elapsed timer 155 stops accumulating time, for purposes of monitoring and tracking time of play, the golfer/golf cart 24 is assumed to have left the course and/or that the game is concluded.

Detailed Description Text (102):
The receiver 240 receives ranging signals from a plurality of antennas 220a-c disposed about the golf course (see discussion regarding FIGS. 1F-H, FIG. 2B and FIG. 3B). The receiver's output signals are provided to the position determining and control signal output means 251, that determines the position of the monitoring and tracking means 350b on the golf course. Using a memory 255 containing the locations of specified features about the course, including the designated start and end areas 23a,b for time of play, the position determining and control signal output means 251 determines if the position of the monitoring and tracking means 350b and the golf cart 25 corresponds to the known location of a start, an end area or one of a plurality of intermediate travel positions 23a-c.

Detailed Description Text (104):
Since the playtime monitoring and tracking means of this embodiment initially determines the location of the golfer/golf cart, the time of play information being accumulated in the memory storage means 161, may be stored to reflect play at various points during the game. Thus, when it is determined that the playtime monitoring and tracking means 350b is at one of the intermediate travel positions 23c, the position determining and control signal output means 251 outputs a control signal causing the elapsed time from the elapsed timer 155 to be written to the memory storage means 161. For example, the time of play when the golfer/golf cart is disposed contiguous the tee for the first hole and the time of play for completing the first hole may be stored in the memory storage means. In this way, course representatives may acquire time information that is used for purposes besides controlling slow play such as optimizing the amount of time to stagger tee off times.

Detailed Description Text (119):
The playtime monitoring and tracking means 350a,b is mounted on the golf cart 24 along with the signal receiving, processing and display means 126,226 of the present invention (FIGS. 3A,B) or it is included in a separate package for golfers who do not use golf carts. When mounted on the golf cart 24, the circuitry of the monitoring and tracking means is preferably included along with the circuitry for the signal receiving, processing and display means 126,226 and more particularly all this circuitry is integrated to eliminate duplicative components (e.g., using one receiver to receive the ranging signals to determine if the cart is located in a restricted area, a start, area an end area or one of the intermediate travel positions).

CLAIMS:

1. A golf cart control and monitoring apparatus, comprising:

signal transmission means for transmitting a plurality of electromagnetic signals, each signal being representative of a position with respect to each of at least one restricted area of a golf course;

signal receiving and processing means for receiving and processing the electromagnetic signals from said signal transmission means and for providing output signals representative of the location of a golf cart with respect to any one of the at least one restricted area, where at least one of said signal receiving and processing means output signals is representative of a golf cart

being located in any one of the at least one restricted area;

event log means, responsive to said signal receiving and processing means output signals, for generating a historical log of at least how long the golf cart was located within any one of the at least one restricted area; and

wherein said signal transmission means includes at least one antenna for radiating the plurality of electromagnetic signals.

2. The golf cart control and monitoring apparatus of claim 1, wherein the historical log being generated by said event log means includes how many times the golf cart has been located in any one of the at least one restricted area.

3. The golf cart control and monitoring apparatus of claim 2, wherein said event log means includes:

an event counter, responsive to said receiver means output signals, for counting each time the golf cart has entered into any of the at least one restricted area; and

time accumulation means, responsive to receiver means output signals, for determining the amount of time the golf cart has been located in any of the at least one restricted area.

4. The golf cart control and monitoring apparatus of claim 3, wherein said event log means further includes:

an event display, responsive to said event counter, that provides a visual display of the total number of restricted area entries; and

a time display, responsive to said time accumulation means, that provides a visual display of the time the golf cart was located in any of the at least one restricted area.

5. The golf cart control and monitoring apparatus of claim 2, wherein said signal receiving and processing means generates a first output signal to indicate that the golf cart is approaching any one of the at least one restricted area of a golf course and generates a second output signal to indicate that the golf cart has entered any one of the at least one restricted area, and wherein said event log means begins to accumulate data upon receipt of said second output signal.

6. The golf cart control and monitoring apparatus of claim 5, wherein said event log means terminates data accumulation when said signal receiving and processing means is not receiving electromagnetic signals from said signal transmission means.

7. The golf cart control and monitoring apparatus of claim 5, wherein said signal receiving and processing means includes a signal sealing means for sealing in said second output signal until said signal receiving and processing means is not receiving electromagnetic signals from said signal transmission means.

8. The golf cart control and monitoring apparatus of claim 5, wherein said signal receiving and processing means includes determining means for determining when the golf cart is approaching any one of the at least one restricted area and when the cart is considered located in any one of the at least one restricted area and for providing said signal receiving and processing means first output signal when the cart is determined to be approaching any one of the at least one restricted area and said signal receiving and processing means second output signal when the cart is considered to be located in any one of the at least one restricted area.

9. The golf cart control and monitoring apparatus of claim 8, wherein the electromagnetic signals being generated by said signal transmission means are signal pulses being repetitively generated at a prespecified interval; and wherein said determining means further includes:

pulse counting means for counting the signal pulses from said signal transmission means, and

means, responsive to said pulse counting means, for causing said signal receiving and processing means to output said second output signal after a prespecified number of signal pulses have been counted.

10. The golf cart control and monitoring apparatus of claim 8, wherein said determining means further includes clock means for determining at least elapsed time, and means responsive to said clock means, for causing said signal receiving and processing means to output said second output signal after a prespecified amount of time has elapsed after said signal receiving and processing means first output signal is initially outputted.

11. The golf cart control and monitoring apparatus of claim 1, in which said apparatus further comprises an external visual warning means, disposed on the golf cart, for generating an external visual signal, visible to golf course representatives at other locations of the golf course, to indicate the position of the golf cart with respect to any one of the at least one restricted area, wherein said external visual warning means is activated responsive to said at least one output signal representative of the golf cart being located in any one of the at least one restricted area.

12. The golf cart control and monitoring apparatus of claim 11, wherein the external visual signal being generated is terminated when said signal receiving and processing means is not receiving electromagnetic signals from said signal transmission means.

13. The golf cart control and monitoring apparatus of claim 11, wherein said external visual warning means further includes a plurality of lights.

14. The golf cart control and monitoring apparatus of claim 13, wherein said external visual warning means further includes a sequencer that controls the lighting of said plurality of lights.

15. The golf cart control and monitoring apparatus of claim 14, wherein said external visual warning means further includes a plurality of switches, controlled by said sequencer, for switchably and selectively energizing each of said plurality of lights so that said lights are sequentially and repetitively lit.

16. The golf cart control and monitoring apparatus of claim, 11, wherein said signal receiving and processing means and said external visual warning means are contained in a single housing.

17. The golf cart control and monitoring apparatus of claim 1, in which said apparatus further comprises visual alarm means, responsive to said signal receiving and processing means for generating visual alarms to a cart operator that are representative of the golf cart's location with respect to any one of the at least one restricted area.

18. The golf cart control and monitoring apparatus of claim 17, wherein said visual alarm means generates a first visual alarm when the golf cart approaches any one of the at least one restricted area and a second visual alarm when the cart is considered to be in any one of the at least one restricted area, where said first and second visual alarms are distinctive from one another.

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19. The golf cart control and monitoring apparatus of claim 18, wherein said signal receiving and processing means further includes determining means for determining when the golf cart is approaching any one of the at least one restricted area and when the cart is considered located in any one of the at least one restricted area and for providing said signal receiving and processing means first output signal when the cart is determined to be approaching any one of the at least one restricted area and said signal receiving and processing means second output signal when the cart is considered to be located in any one of the at least one restricted area; and wherein said first visual alarm is generated in response to said first output signal and said second visual alarm is generated in response to said second output signal.

20. The golf cart control and monitoring apparatus of claim 1, in which said apparatus further comprises auditory alarm means, responsive to said signal receiving and processing means output signals for generating auditory alarm signals to a cart operator that are representative of the golf cart's location with respect to the restricted area.

21. The golf cart control and monitoring apparatus of claim 20, wherein said auditory alarm means generates a first auditory alarm signal when the golf cart approaches a restricted area and a second auditory alarm signal when the cart is considered to be in a restricted area, where said first and second auditory alarm signals are distinctive from one another.

22. The golf cart control and monitoring apparatus of claim 21, wherein said signal receiving and processing means further includes determining means for determining when the golf cart is approaching the restricted area and when the cart is considered located in a restricted area and for providing said signal receiving and processing means first output signal when the cart is determined to be approaching the restricted area and said signal receiving and processing means second output signal when the cart is considered to be located in the restricted area; and wherein said first auditory alarm signal is generated in response to said first output signal and said second auditory alarm signal is generated in response to said second output signal.

23. The golf cart control and monitoring apparatus of claim 1, in which said apparatus further includes a display means for displaying a pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any one of the at least one restricted area, wherein said display means further includes message determining means, responsive to said signal receiving and processing means output signals, for determining the pre-scripted message to be displayed.

24. The golf cart control and monitoring apparatus of claim 1, in which said apparatus further includes a solar electrical power supply means for providing electrical power from ambient light to energize said signal transmitting means.

25. The golf cart control and monitoring apparatus of claim 24, wherein said solar electrical power supply means includes a solar power cell to generate electrical power in response to incident ambient light.

26. The golf cart control and monitoring apparatus of claim 25, wherein said solar electrical power supply means further includes a power control means for regulating and controlling the electrical power from said solar electrical power supply means to said signal transmitting means.

27. The golf cart control and monitoring apparatus of claim 26, wherein said solar electrical power supply means further includes a battery and wherein said power

control means regulates and controls the electrical power being supplied by said battery and said solar cell and wherein said power control means also controls charging of said battery by said solar cell.

28. The golf cart control and monitoring apparatus of claim 26, wherein said solar electrical power supply means further includes means for determining when to electrically interconnect said signal transmitting means to said electrical power supply means and switch means, responsive to said determining means, for switchably interconnecting said solar electrical power supply means and said signal transmitting means, wherein an interconnection is made at times when golf is expected to be played.

29. The golf cart control and monitoring apparatus of claim 28, wherein said determining means further includes a light detection means for detecting ambient light and wherein said switch means interconnects said power supply means and said signal transmitting means when the ambient light detected exceeds a prespecified value.

30. The golf cart control and monitoring apparatus of claim 28, wherein said solar electrical power supply means further includes a power disable switch for disconnecting said signal transmitting means from said solar electrical power supply means.

31. The golf cart control and monitoring apparatus of claim 1, wherein said signal transmission means further comprises:

one antenna for radiating said electromagnetic signals;

a transmitter for generating said electromagnetic signals being radiated by said one antenna; and

a lightning protection device, electrically interconnected to said transmitter and said one antenna, to protect said transmitter and said one antenna from the effects of lightning strikes.

32. The golf cart control and monitoring apparatus of claim 31, wherein said one antenna is disposed below grade.

33. The golf cart control and monitoring apparatus of claim 31, wherein said transmitter has a power output such that the electromagnetic signals being radiated by said one antenna at least cover the entire area bounded by said one antenna.

34. The golf cart control and monitoring apparatus of claim 33, wherein said transmitter has a power output such that the electromagnetic signals being radiated by said one antenna also cover an area that extends radially outward from said one antenna.

35. The golf cart control and monitoring apparatus of claim 1, further comprising:

a second signal transmission means for transmitting a plurality of electromagnetic signals, where one group of the signals is representative of a starting point for play and where a second group of the signals is representative of an ending point for play;

wherein said signal receiving and processing means includes a second receiver means for receiving said second transmission means electromagnetic signals, said signal receiving processing and display means providing a start signal when the first signal group is received and a stop signal when the second signal group is received; and

an elapsed timer that is started in response to the start signal and is stopped in response to the stop signal, wherein said elapsed timer provides outputs of the amount of time that has elapsed since said elapsed timer received the start signal, each output being representative of time of play.

36. The golf cart control and monitoring apparatus of claim 35, further including a time of play display means, responsive to the elapsed timer outputs, for displaying the time of play.

37. The golf cart control and monitoring apparatus of claim 36, wherein there is at least one area designated on the golf course as the starting point for play and at least another area designated on the golf course as the ending point for play; wherein said second signal transmission means includes one antenna disposed at each designated starting point area and a second antenna disposed at each designated ending point area and at least two transmitters, one transmitter for each of said antennas; wherein said signal receiving and processing means further includes two receivers, where one receiver receives the signals being radiated from each starting point antenna and the other receiver receives the signals being radiated from each ending point antenna; and wherein said elapsed timer is started in response to the signals from each starting point antenna and stopped in response to the signals from each ending point antenna.

38. A device for controlling and monitoring the operation of a golf cart on a golf course, the device being responsive to ranging signals from a set of at least three remote transmitters located at known locations about the golf course to define a triangle encompassing a substantial portion of the golf course that includes restricted areas, wherein each of the transmitters transmits a repetitive ranging signal and wherein the combined ranging signals from the set of transmitters defines sets of ranging signals, the control and monitoring device comprising:

receiving means for receiving the sets of ranging signals from the transmitters; and

signal processing and control means, responsive to said receiving means, for processing each received set of ranging signals to determine a location of the golf cart with respect to predetermined features of the golf course and for providing control signals, each said control signal being representative of the location of the golf cart with respect to a given predetermined feature, wherein one of said control signals is representative of a golf cart being located in any one of the restricted areas; and

event log means, responsive to control signals that are representative of the location of the golf cart with respect to any one of the restricted areas, for generating a historical log of how long the golf cart has been located in any of the restricted areas.

39. The golf cart control and monitoring device of claim 38, wherein said signal processing and control means includes:

signal processing means for processing the received sets of ranging signals to provide an indication of the location of the golf cart on the golf course;

a memory for storing data indicating a location of each predetermined feature on the golf course, including an indication of the location of each restricted area;

means for accessing said memory to retrieve the indications of location of each restricted area;

determining means for processing the indication of the location for the golf cart and the indication of location for each restricted area retrieved from said memory

to determine the location of the golf cart with respect to any one of the restricted areas; and

means, responsive to said determining means, for providing control signals representative of the location of the golf cart, where the said one of the control signals representative of the golf cart being located in any one of the restricted areas is provided when said determining means determines that the golf cart is located within any one of the restricted areas.

40. The golf cart control and monitoring device of claim 38, wherein the historical log being generated by said event log means further includes at least how many times the golf cart was located within any of the restricted areas of the golf course.

41. The golf cart control and monitoring device of claim 40, wherein said event log means includes:

an event counter, responsive to said control signals, for counting each time the golf cart has entered into any one of the restricted areas of the golf course; and

time accumulation means, responsive to said control signals, for determining at least the amount of time the golf cart has been located in each of the restricted areas.

42. The golf cart control and monitoring device of claim 41, wherein said event log means further includes:

an event display, responsive to said event counter, that provides a visual display of the number of entries into restricted areas; and

a time display, responsive to said time accumulation means, that provides a visual display of at least the time the golf cart was located in each of the restricted areas.

43. The golf cart control and monitoring device of claim 40, wherein said signal processing and control means generates a first control signal to indicate that the golf cart is in a warning area about any one of the restricted areas and generates a second control signal to indicate that the golf cart has entered any one of the restricted areas, and wherein said event log means begins to accumulate data upon receipt of said second control signal.

44. The golf cart control and monitoring device of claim 43, wherein said event log means terminates data accumulation when said signal processing and control means stops sending said second control signal.

45. The golf cart control and monitoring device of claim 38, further including an external visual warning means, disposed on the golf cart, for generating a visual signal, visible to golf course representatives at other locations of the golf course, to indicate the position of the golf cart with respect to any of the restricted areas, wherein said external visual warning means is activated when said signal processing and control means determines that the golf cart is located in any one of the restricted areas.

46. The golf cart control and monitoring device of claim 45, wherein the visual signal being generated is terminated when said signal processing and control means determines that the golf cart has exited from the any one of the restricted areas.

47. The golf cart control and monitoring device of claim 45, wherein said external visual warning means includes a plurality of lights.

48. The golf cart control and monitoring device of claim 47, wherein said external visual warning means further includes a sequencer that controls the lighting of said plurality of lights.

49. The golf cart control and monitoring device of claim 48, wherein said external visual warning means further includes a plurality of switches, controlled by said sequencer, for switchably and selectively energizing each of said plurality of lights so that said lights are sequentially and repetitively lit.

50. The golf cart control and monitoring device of claim 47, wherein said signal receiving and processing means and said external visual warning means are contained in a single housing.

51. The golf cart control and monitoring device of claim 38, further including a display means for displaying a pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any one of the restricted areas, wherein said display means further includes message determining means, responsive to said control signals, for determining the pre-scripted message to be displayed.

52. The golf cart control and monitoring device of claim 38, further comprising visual alarm means, responsive to control signals representative of the golf cart's location with respect to any one of the restricted areas, for generating visual alarms to a cart operator.

53. The golf cart control and monitoring device of claim 52, wherein said visual alarm means generates a first visual alarm in response to a control signal representative of the golf cart being in a warning area about any one of the restricted areas and generates a second visual alarm in response to the control signal representative of the cart being in any one of the restricted areas, where said first and second visual alarms are distinctive from one another.

54. The golf cart control and monitoring device of claim 53, wherein said signal processing and control means includes determining means for determining when the golf cart is in the warning area and when the cart is in any one of the restricted areas and for providing a first control signal when the cart is determined to be in the warning area and a second control signal when the cart is in any one of the restricted areas; and wherein said first visual alarm is generated in response to said first control signal and said second visual alarm is generated in response to said second control signal.

55. The golf cart control and monitoring device of claim 38, further comprising auditory alarm means, responsive to control signals representative of the golf cart's location with respect to any one of the restricted areas, for generating auditory alarm signals to a cart operator.

56. The golf cart control and monitoring device of claim 55, wherein said auditory alarm means generates a first auditory alarm signal in response to a control signal representative of the golf cart being in a warning area about any one of the restricted areas and a second auditory alarm signal in response to the control signal representative of the cart being in any one of the restricted areas, where said first and second auditory alarm signals are distinctive from one another.

57. The golf cart control and monitoring device of claim 56, wherein said signal processing and control means includes determining means for determining when the golf cart is in the warning area and when the cart is in any one of the restricted areas and for providing a first control signal when the cart is determined to be in the warning area and a second control signal when the cart is in any one of the restricted areas; and wherein said first auditory alarm signal is generated in response to said first control signal and said second auditory alarm signal is

generated in response to said second control signal.

58. The golf cart control and monitoring device of claim 38, predetermined features of the golf course further include each area designated as a starting point for play and each area designated as an ending point for play; wherein said signal processing and control means provides a start control signal after determining the golf cart is located in each designated starting play area and a stop control signal after determining the golf cart is located in each designated ending play area; and wherein said golf cart control and monitoring device further comprises an elapsed timer that is started in response to the start control signal and is stopped in response to the stop control signal, wherein said elapsed timer provides outputs of the amount of time that has elapsed since said elapsed timer received the start control signal, each output being representative of time of play.

59. The golf cart control and monitoring device of claim 58, further comprising time of play display means, responsive to the elapsed timer outputs, for displaying the time of play.

60. A system for controlling and monitoring the operation of a golf cart on a golf course, the system comprising:

a set of at least three remote transmitters located at known locations about the golf course to define a triangle encompassing a substantial portion of the golf course that includes restricted areas, wherein each of the transmitters transmits a repetitive ranging signal and wherein the combined ranging signals from said set of transmitters defines sets of ranging signals;

receiving means for receiving the sets of ranging signals from said set of transmitters;

signal processing and control means, responsive to said receiving means, for processing each received set of ranging signals to determine the location of the golf cart with respect to predetermined features of the golf course and for providing control signals, each said control signal being representative of the location of the golf cart with respect to a given predetermined feature, wherein one of said control signals is representative of the golf cart being located in any one of the restricted areas; and

event log means, responsive to control signals that are representative of the location of the golf cart with respect to any one of the restricted areas, for generating a historical log of how long the golf cart has been located in any one of the restricted areas.

61. The golf cart control and monitoring system of claim 60, wherein said signal processing and control means includes:

signal processing means for processing the received sets of ranging signals to provide an indication of the location of the golf cart on the golf course;

a memory for storing data indicating the location of each predetermined feature on the golf course including an indication of the location of each restricted area;

means for accessing said memory to retrieve the indications of location of each restricted area;

determining means for processing the indication of the location for the golf cart and the indication of location for each restricted area retrieved from said memory to determine the location of the golf cart with respect to any one of the restricted areas; and

means, responsive to said determining means, for providing control signals representative of the location of the golf cart, where the said one of the control signals representative of the golf cart being located in any one of the restricted areas is provided when said determining means determines that the golf cart is located within any one of the restricted areas.

62. The golf cart control and monitoring system of claim 60, wherein the historical log being generated by said event log means further includes at least how many times the golf cart was located within any one of the restricted areas of the golf course.

63. The golf cart control and monitoring system of claim 62, wherein said event log means includes:

an event counter, responsive to said control signals, for counting each time the golf cart has entered into any one of the restricted areas of the golf course; and

time accumulation means, responsive to said control signals, for determining at least the amount of time the golf cart has been located in each of the restricted areas.

64. The golf cart control and monitoring system of claim 63, in which said event log means further includes:

an event display, responsive to said event counter, that provides a visual display of the number of restricted area entries; and

a time display, responsive to said time accumulation means, that provides a visual display of at least the time the golf cart was located in each of the restricted areas.

65. The golf cart control and monitoring system of claim 62, wherein said signal processing and control means generates a first control signal to indicate that the golf cart is in a warning area about any one of the restricted areas and generates a second control signal to indicate that the golf cart is in any one of the restricted areas, and wherein said event log means begins to accumulate data upon receipt of said second control signal.

66. The golf cart control and monitoring system of claim 65, wherein said event log means terminates data accumulation when said signal processing and control means stops sending said second control signal.

67. The golf cart control and monitoring system of claim 60, in which said system further includes an external visual warning means, disposed on the golf cart, for generating a visual signal, visible to golf course representatives at other locations of the golf course, to indicate the position of the golf cart with respect to any of the restricted areas, wherein said external visual warning means is activated when said signal processing and control means determines that the golf cart is located in any one of the restricted areas.

68. The golf cart control and monitoring system of claim 67, wherein the visual signal being generated is terminated when said signal processing and control means determines that the golf cart has exited from the any one of the restricted areas.

69. The golf cart control and monitoring system of claim 67, wherein said external visual warning means includes a plurality of lights.

70. The golf cart control and monitoring system of claim 69, wherein said external visual warning means further includes a sequencer that controls the lighting of said plurality of lights.

71. The golf cart control and monitoring system of claim 70, wherein said external visual warning means further includes a plurality of switches, controlled by said sequencer, for switchably and selectively energizing each of said plurality of lights so that said lights are sequentially and repetitively lit.

72. The golf cart control and monitoring system of claim 67, wherein said signal receiving and processing means and said external visual warning means are contained in a single housing.

73. The golf cart control and monitoring system of claim 60, in which said system further includes a display means for displaying a pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any one of the restricted areas, wherein said display means further includes message determining means, responsive to said control signals, for determining the prescripted message to be displayed.

74. The golf cart control and monitoring system of claim 60, in which said system further comprises visual alarm means, responsive to control signals representative of the golf cart's location with respect to any one of the restricted areas, for generating visual alarms to a cart operator.

75. The golf cart control and monitoring system of claim 74, wherein said visual alarm means generates a first visual alarm in response to a control signal representative of the golf cart being in a warning area about any one of the restricted areas and generates a second visual alarm in response to the control signal representative of the cart being in any one of the restricted areas, where said first and second visual alarms are distinctive from one another.

76. The golf cart control and monitoring system of claim 75, wherein said signal processing and control means includes determining means for determining when the golf cart is in the warning area and when the cart is in any one of the restricted areas and for providing a first control signal when the cart is determined to be in the warning area and a second control signal when the cart is in any one of the restricted areas; and wherein said first visual alarm is generated in response to said first control signal and said second visual alarm is generated in response to said second control signal.

77. The golf cart control and monitoring system of claim 60, in which said system further comprises auditory alarm means, responsive to control signals representative of the golf cart's location with respect to any one of the restricted areas, for generating auditory alarm signals to a cart operator.

78. The golf cart control and monitoring system of claim 77, wherein said auditory alarm means generates a first auditory alarm signal in response to a control signal representative of the golf cart being in a warning area about any one of the restricted areas and a second auditory alarm signal in response to the control signal representative of the cart being in any one of the restricted areas, where said first and second auditory alarm signals are distinctive from one another.

79. The golf cart control and monitoring system of claim 78, wherein said signal processing and control means includes determining means for determining when the golf cart is in the warning area and when the cart is in any one of the restricted areas; wherein said signal processing and control means provides the first control signal when the cart is determined to be in the warning area and the second control signal when the cart is in any one of the restricted areas; and wherein said first auditory alarm signal is generated in response to said first control signal and said second auditory alarm signal is generated in response to said second control signal.

80. The golf cart control and monitoring system of claim 60, wherein the predetermined features of the golf course further include each area designated as a starting point for play and each area designated as an ending point for play; wherein said signal processing and control means provides a start control signal after determining the golf cart is located in each designated starting play area and a stop control signal after determining the golf cart is located in each designated ending play area; and wherein said golf cart controlling and monitoring system further comprises an elapsed timer that is started in response to the start control signal and is stopped in response to the stop control signal, wherein said elapsed timer provides outputs of the amount of time that has elapsed since said elapsed timer received the start control signal, each output being representative of time of play.

81. The golf cart control and monitoring system of claim 80 further comprising time of play display means, responsive to the elapsed timer outputs, for displaying the time of play.

82. A system for controlling and monitoring the operation of a golf cart on a golf course, the system comprising:

a set of at least three remote transmitters located at known locations about the golf course to define a triangle encompassing a substantial portion of the golf course that includes each area on the golf course designated as a starting point for play and each area on the golf course designated as an ending point for play, wherein each of the transmitters transmits a repetitive ranging signal and wherein the combined ranging signals from said set of transmitters defines sets of ranging signals;

receiving means for receiving the sets of ranging signals from said set of transmitters;

signal processing and control means, responsive to said receiving means, for processing each received set of ranging signals to determine the location of the golf cart with respect to predetermined features of the golf course and for providing control signals, each said control signal being representative of the location of the golf cart with respect to a given predetermined feature, wherein one of said control signals, a start control signal, is representative of the golf cart being located in each designated starting point area and another of said control signals, a stop control signal, is representative of the golf cart being located in each designated ending point area; and

an elapsed timer that is started in response to the start control signal and is stopped in response to the stop control signal, wherein said elapsed timer provides outputs of the amount of time that has elapsed since said elapsed timer received the start control signal, each output being representative of time of play.

83. The golf cart control and monitoring system of claim 82, wherein said signal processing and control means includes:

signal processing means for processing the received sets of ranging signals to provide an indication of the location of the golf cart on the golf course;

a memory for storing data indicating the location of each predetermined feature on the golf course including an indication of the location of each starting point area and each ending point area;

means for accessing said memory to retrieve the indications of location of each predetermined feature;

determining means for processing the indication of the location for the golf cart and the indication of location for each predetermined feature retrieved from said memory to determine the location of the golf cart with respect to at least one of each starting point area and each ending point area; and

means, responsive to said determining means, for providing control signals representative of the location of the golf cart, where the start control signal is provided when said determining means determines that the golf cart is located in each designated starting point area and the stop control signal is provided when said determining means determines that the golf cart is located in each designated ending point area.

84. The golf cart control and monitoring system of claim 82, further comprising time of play display means, responsive to the elapsed timer outputs, for displaying the time of play.

85. The golf cart control and monitoring system of claim 82, further comprising memory storage means for storing the elapsed timer outputs representative of the time of play.

86. The golf cart control and monitoring system of claim 85, further comprising means for retrieving at least the time of play for a game from said memory storage means and displaying the retrieved time of play to course representatives.

87. The golf cart control and monitoring system of claim 82, wherein the predetermined features further includes restricted areas of the golf course; wherein said signal processing and control means provides another control signal after determining the golf cart is located in any one of the restricted areas and in which said system further includes an event log means, disposed on the golf cart and being responsive to the control signal representative of the location of the golf cart with respect to any one of the restricted areas, for generating a historical log of how many times and for how long the golf cart has been located within any one of the restricted areas of a golf course, wherein said event log means includes:

(i) means, responsive to the signal processing and control means control signals, for counting each time the golf cart has entered into any one of the restricted areas and for providing a visual display to a golf cart operator of the total number of restricted area entries; and

(ii) time means, responsive to the signal processing and control means control signals, for determining the cumulative amount of time the golf cart has been located in any one of the restricted areas and for providing a visual display to the golf cart operator of the cumulative time.

88. The golf cart control and monitoring system of claim 87, wherein said signal processing and control means generates a first control signal to indicate that the golf cart is approaching any one of the restricted areas and generates a second control signal to indicate that the golf cart has entered any one of the restricted areas; wherein said event log means begins to accumulate data upon receipt of the second control signal; and wherein said event log means terminates data accumulation upon receipt of the first control signal.

89. The golf cart control and monitoring system of claim 87, further including a display means, disposed on the golf cart, for displaying at least one pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any one of the restricted areas, wherein said display means further includes message determining means, responsive to said receiver means output signals, for determining the pre-scripted message to be displayed.

90. A golf cart control and monitoring apparatus, comprising:

signal transmission means for transmitting a plurality of electromagnetic signals, where one group of the signals is representative of a starting point for play and where a second group of the signals is representative of an ending point for play;

signal receiving processing and display means for receiving, and processing the electromagnetic signals from said signal transmission means and for providing output signals representative of the location of a golf cart, wherein said signal receiving processing and display means provides a start signal when the first signal group is received and a stop signal when the second signal group is received; and

an elapsed timer that is started in response to the start signal and is stopped in response to the stop signal, wherein said elapsed timer provides outputs of the amount of time that has elapsed since said elapsed timer received the start signal, each output being representative of time of play.

91. The golf cart control and monitoring apparatus of claim 90, wherein said signal receiving processing and display means includes time of play display means, responsive to the elapsed timer outputs, for displaying the time of play.

92. The golf cart control and monitoring apparatus of claim 91, wherein there is at least one area designated on the golf course as the starting point and at least another area designated on the golf course as the ending point; wherein said signal transmission means includes one antenna disposed at each of the at least one starting point area and a second antenna disposed at each of the at least one ending point area and a transmitter for each of said antennas; wherein said signal receiving processing and display means further includes two receivers, where one receiver receives the signals being radiated from said antenna at each of the at least one starting point area and the other receiver receives the signals being radiated from said antenna at each of the at least one ending point area; and wherein said elapsed timer is started in response to the signals from each starting point antenna and stopped in response to the signals from each ending point antenna.

93. The golf cart control and monitoring apparatus of claim 92, wherein said transmitter for the starting point area antenna transmits at a different frequency than said transmitter for the ending point area antenna and wherein said receivers are each configured to receive the electromagnetic signals at the frequency being used for transmission.

94. The golf cart control and monitoring apparatus of claim 90, further comprising memory storage means for storing the elapsed timer outputs from the elapsed timer representative of the time of play.

95. The golf cart control and monitoring apparatus of claim 94, further comprising means for retrieving at least the time of play for a game from said memory storage means and displaying the retrieved time of play to course representatives.

96. The golf cart control and monitoring apparatus of claim 90, further comprising:

second signal transmission means for transmitting a plurality of electromagnetic signals, each signal being representative of a position with respect to each of at least one restricted area of a golf course, wherein said second signal transmission means includes at least one antenna for radiating the plurality of electromagnetic signals;

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wherein said signal receiving processing and display means includes a means for receiving and processing the electromagnetic signals from said second signal transmission means and for providing output signals representative of the location of a golf cart with respect to any one of the at least one restricted area, where at least one of said signal receiving and processing means output signals is representative of a golf cart being located in any one of the at least one restricted area; and

event log means, responsive to the signal receiving and processing means output signals representative of the location of the cart with respect to any one of the at least one restricted area, for generating a historical log of how long and how many times the golf cart was located within any of the at least one restricted area of the golf course.

97. The golf cart control and monitoring apparatus of claim 96, wherein said event log means includes:

means, responsive to the signal receiving and processing means output signals representative of the cart being in any one of the at least one restricted area, for counting each time the golf cart has entered into any one of the at least one restricted area and for providing a visual display to a golf cart operator of the total number of restricted area entries; and

time means, responsive to the signal receiving and processing means output signals representative of the location of the cart with respect to any one of the at least one restricted area, for determining the cumulative amount of time the golf cart has been located in any one of the at least one restricted area and for providing a visual display to the golf cart operator of the cumulative time.

98. The golf cart control and monitoring apparatus of claim 97, wherein said signal receiving processing and display means generates a first control signal to indicate that the golf cart is approaching any one of the at least one restricted area and generates a second control signal to indicate that the golf cart has entered any one of the at least one restricted area; wherein said event log means begins to accumulate data upon receipt of the second control signal; and wherein said event log means terminates data accumulation when said signal receiving and processing means is not receiving electromagnetic signals from said second signal transmission means.

99. The golf cart control and monitoring apparatus of claim 96, wherein said signal receiving processing and display means further includes a display means, disposed on the golf cart, for displaying at least one pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any of the at least one restricted area, wherein said display means further includes message determining means, responsive to the signal receiving and processing means output signals representative of the location of the cart with respect to any one of the at least one restricted area, for determining the pre-scripted message to be displayed.

114. The golfing control and monitoring apparatus of claim 100, wherein said hole determining means includes:

a set of at least three remote transmitters located at known locations about the golf course to define a triangle encompassing a substantial portion of the golf course that includes predetermined features such as each area on the golf course designated as a starting point for play, each area on the golf course designated as an ending point for play and each area on the golf course designated as an intermediate play position, wherein each of the transmitters transmits a repetitive ranging signal and wherein the combined ranging signals from said set of transmitters defines sets of ranging signals;

receiving means for receiving the sets of ranging signals from said set of transmitters; and

signal processing and control means, responsive to said receiving means, for processing each received set of ranging signals to determine the location of the golf cart with respect to the predetermined features of the golf course and for providing control signals, each said control signal being representative of the location of the golf cart with respect to a given predetermined feature, wherein a start control signal is provided when the golf cart is determined to be located in each designated starting point area, wherein a stop control signal is provided when the golf cart is determined to be located in each designated ending point area, and wherein an intermediate play position control signal is provided when the golf cart is determined to be located at each designated intermediate play positions on the golf course.

117. The golfing control and monitoring apparatus of claim 114, wherein said signal processing and control means includes:

signal processing means for processing the received sets of ranging signals to provide an indication of the location of the golf cart on the golf course;

a memory for storing data indicating the location of each predetermined feature on the golf course including an indication of the location of each starting point area, each ending point area and each intermediate play position;

means for accessing said memory to retrieve the indications of location of each predetermined feature;

determining means for processing the indication of the location for the golf cart and the indication of location for each predetermined feature retrieved from said memory to determine the location of the golf cart with respect to the predetermined feature; and

means, responsive to said determining means, for providing control signals representative of the location of the golf cart, where the start control signal is provided when said determining means determines that the golf cart is located in the designated starting point area and the stop control signal is provided when said determining means determines that the golf cart is located in the designated ending point area.

118. The golfing control and monitoring apparatus of claim 121, wherein the predetermined features of the golf course further include restricted areas; wherein said memory stores an indication of the location of each restricted area of the golf course, wherein one of the control signals of said signal processing and control means is representative of the golf cart being located in any one of the restricted areas and in which said system further includes an event log means, disposed on the golf cart and being responsive to the control signals that are representative of the location of the golf cart with respect to any one of the restricted areas, for generating a historical log of how many times and for how long the golf cart has been located within any one of the restricted areas of a golf course, wherein said event log means includes:

(i) means, responsive to the signal processing and control means control signals, for counting each time the golf cart has entered into any one of the restricted areas and for providing a visual display to a golf cart operator of the total number of restricted area entries; and

(ii) time means, responsive to the signal processing and control means control signals, for determining the cumulative amount of time the golf cart has been

located in any one of the restricted areas and for providing a visual display to the golf cart operator of the cumulative time.

119. The golfing control and monitoring apparatus of claim 118, wherein said signal processing and control means generates a first control signal to indicate that the golf cart is approaching any one of the restricted areas and generates a second control signal to indicate that the golf cart has entered any one of the restricted areas; wherein said event log means begins to accumulate data upon receipt of the second control signal; and wherein said event log means terminates data accumulation upon receipt of the first control signal.

120. The golfing control and monitoring apparatus of claim 119, in which said apparatus further includes a display means, disposed on the golf cart, for displaying at least one pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any one of the restricted areas, wherein said display means further includes message determining means, responsive to said receiver means output signals, for determining the pre-scripted message to be displayed.

121. The golfing control and monitoring apparatus of claim 100, wherein said hole determining means includes:

signal transmission means for transmitting a plurality of electromagnetic signals, where one group of the signals is representative of a starting point for play, where a second group of the signals is representative of an ending point for play, and where a third group of signals is representative of an intermediate play position; and

signal receiving processing and display means for receiving and processing the electromagnetic signals from said signal transmission means and for providing output signals representative of the location of a golf cart, wherein said signal receiving processing and display means provides a start signal when the first signal group is received, provides a stop signal when the second signal group is received, and provides an intermediate play position signal when the third signal group is received.

125. The golfing control and monitoring apparatus of claim 121, further comprising:

second signal transmission means for transmitting a plurality of electromagnetic signals, each signal being representative of a position with respect to each of at least one restricted area of the golf course, wherein said second signal transmission means includes at least one antenna disposed proximate each of the at least one restricted area for radiating the plurality of electromagnetic signals;

wherein said signal receiving processing and display means includes a means for receiving and processing the electromagnetic signals from said second signal transmission means and for providing output signals representative of the location of a golf cart with respect to any one of the at least one restricted area, where at least one of said signal receiving and processing means output signals is representative of a golf cart being located in any one of the at least one restricted area; and

event log means, responsive to the signal receiving and processing means output signals representative of the location of the cart with respect to any one of the at least one restricted area, for generating a historical log of how long and how many times the golf cart was located within any one of the at least one restricted area.

126. The golfing control and monitoring apparatus of claim 125, wherein said event log means includes:

means, responsive to the signal receiving and processing means output signals representative of the cart being in any one of the at least one restricted area, for counting each time the golf cart has entered into any one of the at least one restricted area and for providing a visual display to a golf cart operator of the total number of restricted area entries; and

time means, responsive to the signal receiving and processing means output signals representative of the location of the cart with respect to any one of the at least one restricted area, for determining the cumulative amount of time the golf cart has been located in any one of the at least one restricted area and for providing a visual display to the golf cart operator of the cumulative time.

127. The golfing control and monitoring apparatus of claim 121, wherein said signal receiving processing and display means includes a display means, disposed on the golf cart, for displaying at least one pre-scripted message selected from among at least one available prescripted message, the displayed message advising a golf cart operator of the cart's location with respect to any one of at least one restricted area, wherein said display means further includes message determining means, responsive to the signal receiving and processing means output signals, for determining the prescripted message to be displayed.

Refine Search

Search Results -

Terms	Documents
(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage adj (information or record$3))	0

Database: US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

Search: (optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage

Refine Search | Recall Text | Clear | Interrupt

Search History

DATE: Friday, March 19, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=NO; OP=OR			
L6	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage adj (information or record$3))	0	L6
L5	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance)	11	L5
L4	l3	25	L4
L3	(optimiz$5 and (golf adj (car or cart))) and (id or identification)	25	L3
L2	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification)	0	L2
L1	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification) and (odometer or (axle adj revolutions) or milage)	0	L1

END OF SEARCH HISTORY

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Refine Search

Search Results -

Terms	Documents
(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage adj (information or record$3))	0

Database: US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

Search: (optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage

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DATE: Friday, March 19, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=NO; OP=OR			
L6	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance) and (usage adj (information or record$3))	0	L6
L5	(optimiz$5 and (golf adj (car or cart))) and (id or identification) and (rent$3) and (maintenance)	11	L5
L4	l3	25	L4
L3	(optimiz$5 and (golf adj (car or cart))) and (id or identification)	25	L3
L2	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification)	0	L2
L1	(optimiz$5 adj5 (golf adj (car or cart))) and (id or identification) and (odometer or (axle adj revolutions) or milage)	0	L1

END OF SEARCH HISTORY

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